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THE GLASS INDUSTRY

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GOOD HOUSEKEEPING IMPROVES EFFICIENCY AND MORALE AT MISSISSIPPI GLASS

By JOHN A. MAZZONI, Manager

Mississippi Glass Company, St. Louis, Missouri

Four years ago, fostered by the lively interest of its President, Paul L. Hershfield, Mississippi Glass Company embarked on a good housekeeping program which today has resulted in a plant operation vastly improved by management-employee cooperation in effecting and maintaining clean and orderly working conditions.

The program instituted by the glass company contained several basic goals which were set forth in order to achieve an orderly plant. The first of these goals was the education of department heads in the necessity and importance of good housekeeping. It was felt that in order to satisfactorily install a housekeeping program, plant management and supervision must be aware of the many benefits to be derived from a clean and orderly plant.

Each department head was contacted, individually and collectively, and areas in the various departments needing attention were pointed out to the supervisor in charge. The good points of the department were also commented upon. The department head was asked for his ideas and suggestions concerning the improvement of his department's housekeeping, and these ideas were catalogued and the necessary action taken to put his ideas or suggestions into effect.

Throughout the supervisory indoctrination, plant management continually reminded the supervisor that he, being the head of the department, must be the model. At the same time, he was to begin to educate his group in the benefits to be derived from good housekeeping habits. Whenever it was found that a supervisor was a collector of miscellaneous odds and ends, such material was carefully examined by plant management. Material being used was kept and placed in lockers provided for such equipment; material merely cluttering up the area was disposed of. Eventually the effects of the supervisory indoctrination began to make itself evident. Then, and only then was the second goal of the housekeeping program initiated.

This second goal was employee indoctrination. In order to fulfill the objectives set forth, it was necessary to impress upon each and every employee the importance of maintaining his work area, his lunch area and the wash room areas in a clean and orderly fashion. This was not an easy job. Whenever employees were permitted to carelessly scatter debris about, they did not feel it necessary to correct the results of their thoughtlessness. It was a continual effort on the part of plant management and supervision in employee education to impress upon the employee the benefits to be obtained from uncluttered work areas.

In order to educate the employees fully, the program was designed to personally reach employees or groups of employees who were lax in their housekeeping habits. They were instructed to pick up and clean up in the area in which they worked; bulletins were posted concerning the appearance of various departments and areas; and, above all, employee's suggestions were listened to with interest and consideration. It was felt that once interest of this nature was shown by the employees, the project was well on its way towards success.

In keeping with employee education and the employee suggestion plan, it was necessary to purchase the necessary equipment so vital to the maintenance of a clean plant. Here is where the vital cooperation of top management made itself felt. Improved lighting, heating and ventilation conditions were installed; painting of entire departments initiated; refuse cans were installed. All of these

items are directly connected with employee education and employee morale in an orderly plant. Mississippi Glass Company's management began an extensive Plant Paint Program, Plant Lighting Program, Plant Heating Program and Plant Ventilation Program. The results of these four programs, which are items in the over-all objective, immediately bore fruit. When the employees found that top management, along with plant management, was eager to do its share in bringing about good housekeeping throughout the plant, they became more conscious of their ways and habits. Departments began to look orderly and smoothly run, efficiency improved and a spirit of good fellowship prevailed.

Along with the purchase of the equipment already mentioned, two mechanical sweepers were purchased which were immediately put into operation to sweep area-ways, and department and yard areas throughout the plant. The resultant improved appearance of all working areas impressed the employees beyond a doubt that plant housekeeping was a mutual problem, and once they realized that management was working with them toward a common goal, employee education was made simpler.

The new employee is a constant challenge to plant management. Whenever a new employee is put to work, his supervisor immediately instructs him in the objectives of good housekeeping practices. The new employee is told that he is responsible for his work area—he must keep it clean and he must keep it orderly.

It has been found at Mississippi Glass Company's St. Louis plant that the most direct way to impress upon each employee and each department as a whole that housekeeping is everybody's problem is to make sure that the employee, or department, takes care of its own apartment, so to speak. The company does not have labor crews to go through the plant doing clean-up work. Each department is charged with the responsibility of maintaining that department in the best possible condition. Each department head knows that he is free to suggest improvements in his department and he can be sure that any reasonable suggestion will be carried out.

The third and most costly goal in the good housekeeping program was that of plant renovation and plant maintenance. While the Plant Paint Program, Plant Lighting Program, Plant Heating Program and Plant Ventilation Program were desirable from the standpoint of employee morale, it was not entirely the answer to the problem. Therefore, management instituted a program whereby the buildings of the entire plant were given a thorough inspection and necessary repairs to these buildings listed and proper action taken. The St. Louis plant has been given a thorough renovation in all its buildings, inside and out. The roofs of all buildings have been checked and repaired where necessary. All buildings were checked to insure that all sash were properly glazed; exteriors of the buildings were checked and, in many instances, painted so that greatly improved appearance and protection were achieved. Following inspection of the entire plant, management secured bids to have all areas which were not concrete or hard top to be hard-topped so that material handling equipment and employees would have solid footing throughout the plant. Thus far the greater majority of the areas which were formerly chat-covered have now been entirely black-topped or concreted.

While this presents an outline of the main objectives of the Plant Housekeeping Program at Mississippi Glass Company, and the improvements resulting are quite pronounced, the goal is still to press forward. It is not the intention of top management for plant management to become complacent and drift into the old bad habits. Experience has thus far shown that the clean and orderly plant is a happy and efficient one. It is evident to all that only through the mutual assistance and complete cooperation of top management, plant management and the employee can the good housekeeping program be effective and continually maintained.

It is believed that at Mississippi Glass the employees have learned the benefits to be derived from an orderly plant and that they, too, have made the success of the Program a personal one. To sustain the success of the plan, it is essential that the continued efforts of one and all be maintained at the highest level. Frequent inspections and employee bulletins commenting upon an area's appearance will keep interest at a high pitch. Plant housekeeping is a constant fight and one that requires the efforts of all concerned to succeed.

GLASS CONTAINER INDUSTRY AND UNION REACH AGREEMENT

The wage conference for a new contract between the AFL Glass Bottle Blowers Association and the glass container industry has concluded successfully, it has been announced by Lee W. Minton, G.B.B.A. President. Nine days of negotiations ended with an agreement which provided an industry-wide pension for all employees of $35 per month maximum at the age of 65, with the entire cost to be paid by the employers. Ralph A. Lind, Director of Labor Relations of the Glass Container Manufacturers Institute, confirmed the Minton release in all substantial details.

A wage increase of 5¢ per hour was also granted, bringing minimum wages up to $1.82 per hour for operators, plus an incentive bonus in most plants of 20% to 30% additional. In several plants, the wage rise was 3¢ per hour to bring rates into line with others in the industry.

The new contract is for a period of 3 years, starting March 1, 1954, with provisions for wage reopenings each year. An arbitration clause was added providing for arbitration of grievances which cannot be settled by the normal grievance procedure provided in the contract. A new provision was adopted providing for payment for holidays when they occur during the worker's vacation period. The operators contract covers 7,000 machine operators and helpers. Negotiations for miscellaneous employees began the week of March 1.

SIDEWALL AND SUPERSTRUCTURE REFRACTORIES APPLICATION IN GLASS TANKS

By O'MARA WHITE

The Carborundum Co., Perth Amboy, New Jersey

Introduction

Glass furnace operators and engineers constantly strive to improve tank life, production, glass quality and unit cost. There has been much accomplished along these lines in recent years due in large part to the open-mindedness and cooperative attitude of plant operators toward refractories manufacturers who recognize and accept certain responsibilities in research, development and application of their products. As no universal refractory for continuous glass melting furnaces has been perfected, the need for this mutual approach still is essential in attaining the objectives cited. In this presentation, current refractories usage in both sidewalls and superstructure will be described, with emphasis on preferred materials to offset specific problems.

In considering the various types and makes of average refractories for use in melting and refining end sidewalls, a number of factors usually influence the user's final selection. Type of glass, glass color, glass composition, tank depth, refractory cost, plant location and experiences of both operators and refractory suppliers are a few of these factors.

Today the majority of continuous tanks contain a combination of refractories in the melting end sidewalls. They were selected and/or designed to give a certain degree of balance from the standpoints of service and cost in this most important area of tank structure. In the refining end sidewalls, it has been general practice to use one type of refractory, be it fusion cast or clay, rather than a combination.

The corrosion and erosion resistance to sintered batch and molten glass is one of the primary considerations in determining the effectiveness of tank block material. Its effect on glass quality is of equal importance.

The refractories generally available and most commonly used for sidewall service in continuous tanks include fusion cast of several different compositions and the hand or machine-made bonded and slip cast alumina-silica types of materials. Several refractory compositions are being used successfully for sidewall service against special glasses, but these will not be dealt with at this time. A number of tanks still use either bonded flux alone or bonded flux with fusion cast blocks, but for the majority of tanks, however, fusion cast refractories provide far superior resistance to corrosion and erosion of glass under present-day high operating temperatures. Longer furnace life is realized, and there are fewer refractory contaminants in the glass melt.

At the present time, four separate and distinct fusion cast mixes are commercially available for sidewall usage. The mullite fusion cast product, approximating 72% alumina and 20% silica and which was more than adequate in meeting the demands of the industry for years following its introduction, is today being replaced rapidly with new and improved fusion cast mixes. The latter offer considerably greater corrosion resistance, and although more expensive, their improved service justifies the added cost.

More recent mixes now being extensively used in sidewalls include the zirconia-alumina mix consisting of approximately 40% zirconia, 40% alumina and 10% silica; the high-alumina mix consisting of approximately 98% alpha and beta alumina; and the chrome-alumina mix consisting of approximately 80% alumina and 9% chromite.

It is the opinion of most tank operators that the three newer sidewall block compositions are quite comparable from the standpoint of over-all erosion. However, the high-alumina compositions appear to have superior resistance to joint erosion and upward drilling.

From both theoretical and practical viewpoints, it seems desirable to reduce or eliminate the glassy phase and impurities in fusion cast products. The 98%-alumina product not only contains a very minor percentage of interstitial glass, but, being made from chemically-pure materials, offers absence of discoloration and has a tendency to reduce possibilities of seeds, blisters and other refractory-caused contaminants. Since the erosion resistant qualities of the latter three products are all excellent, they are today adequately meeting the sidewall service demands of the industry. In fact, it may be generally stated that other parts of the average furnace must be strengthened to balance out with sidewalls.

All three products cast under normal conditions produce blocks having near zero porosity, with an inherent pipe or cavity located in the area beneath the casting scar. In spite of this considered weakness, very excellent results have and are being obtained. While we must be content with the normal product, recent developments have made it possible, where necessary, to locate the cavity in full-depth sidewall blocks in such a position as to make its effect almost negligible. It is expected that this improved technique will eventually enable the industry to make still further strides in the way of tank life and tonnage production.

As improved and more costly fusion cast and bonded-type tank blocks were developed, many glass operators again considered and reverted to multiple-course sidewall construction in melting ends and, in some cases, refining ends. This type of construction embodied the higher quality fusion cast in the top course metal line area, with lower quality fusion cast—in some instances, clay—in the lower courses. These were considered natural progressive moves designed to take advantage of the more resistant product on the most economic basis. In other cases, the higher quality fusion cast materials were used for both top and bottom courses, with the idea of receiving the additional benefits and having to replace only the top course when making repairs.

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There was some justification at the time in this line of thinking. However, it now appears that while some benefits were derived, the trend in the majority of cases is back to full-depth sidewalls. This does not include flat glass tanks where multiple courses work to definite advantage, although the number of courses is gradually being reduced. The reasons for this reversed trend may be given as follows:

(1) On tanks producing clear and in many cases colored glasses, horizontal joint attack from erosion has usually been found severe following long campaigns. Quite often, lower-priced, less resistant materials in lower courses have shown more attack than the improved-product at the vulnerable metal line area. Experiences such as this bring about a certain degree of risk not otherwise present with full-depth blocks. Excessive attack at the horizontal joint or in a lower course block could be the cause for premature tank shutdown or failure. In the event overcoating may be required in this area to obtain reasonable furnace life, there is a possibility of losing the top course. It might be well to point out that in such a situation the savings gained through the use of less-resistant materials may well be lost through the added material and labor cost of extensive overcoating.

(2) In view of the life of present-day campaigns, major rebuilds requiring replacement of at least complete melting end sidewalls are a practical economic necessity. Therefore, in many furnaces, there can be little justification in attempting to reuse lower course materials when considering the small savings involved against the major investment to be made in the repair.

(3) The necessity of having to replace furnace bottoms after one campaign has had a bearing on multiple-course construction ideas. Whether one product or a combination of products may be used in multiple courses, it is not generally considered practical nor economical to remove and re-install lower course materials where the bottom requires replacement.

(4) Full-depth sidewalls having fewer joints than in the case of multiple courses require less bracing and are easier to air cool. The labor required to install full-depth blocks is less than that required for setting multiple courses. Full-depth blocks eliminate any possibility of horizontal joints opening up during heat-up periods and simplify the problem of control on sidewall expansion.

(5) In the case of full-depth fusion cast blocks, the single casting scar would be located in the center or lower portion of the sidewall, whereas with two-course construction, two cavities will be in existence with one close to the metal line area.

In view of the ever-continuing effort on the part of glass manufacturers to improve glass quality, many operators and glass technologists are of the opinion it is false economy to use a less-resistant product in the lower courses, thereby contributing to additional refractory contamination.

It should be clearly understood for reasons outlined that although full-depth sidewall construction has many advantages over multiple courses and, therefore, predominates, the latter has its place in the industry. The particular tank or tanks in question and the many factors concerning operation must be considered in determining both construction and materials most suitable.

In recent years, several glass manufacturers have reported successful results in partially and completely insulating fusion cast melting end sidewalls. Test work is being continued on some commercially operated tanks, and it is felt that some fuel savings have been effected, thus justifying the program. This work is being carried out on tanks producing both flint and colored glasses. In at least one instance on a colored glass, it has been reported that along with a fuel savings, some improvement in glass quality also resulted. In spite of these favorable reports, the insulation of melting end sidewalls should be considered still experimental and treated with caution.

With tank sidewall life improved through the use of more resistant sidewall materials, more attention is being given to the selection of refractories for superstructure in order to obtain balance.

As in the case of sidewall refractories, there are a number of different types and compositions available for use in the superstructure area of tanks proper. These areas of use include tuckstones, port bottoms, breastwalls, port jambs and port arches, including in some instances an adjacent section of the furnace crown. They may be constructed of any one or combination of refractories to give a reasonable degree of balance in meeting the service requirements in any particular tank. The most commonly used refractories for these specific locations include silica, sillimanite, bonded high alumina and fusion cast of several compositions. The refractories as may be used in these areas are usually called upon to resist high operating temperatures, flame impingement, volatilized alkalies, batch dust and temperature changes. Failure of the refractories in any one location can necessitate costly hot repairs, loss of production, poor glass quality and possible premature furnace shutdown.

While some operators attempt to standardize where possible, there are almost as many different types and designs of port construction in the industry as there are furnaces. There are also numerous methods of firing using one and, more often, two types of fuel during a campaign. As a result, the experience with refractories may vary from tank to tank and from one campaign to another on the same furnace. Thus, there are varying factors, a few of which are tank life, rate of production, possible changes in batch material and temperature, that affect the ever-changing picture.

Conditions in some furnaces are such as to make it possible to use silica or bonded refractories throughout the breastwalls and port areas, with bonded or fusion cast tuckstones and port bottoms. In other furnaces, conditions warrant the use of fusion cast for tuckstones, port bottoms, and the back two-thirds of the breastwall and port areas. Still others require fusion cast of one or more mixes throughout.

The zirconia-alumina, mullite and 98%-alpha beta alumina fusion cast products previously mentioned for sidewall applications are also extensively used for superstructure service. In addition, a special product made from chemically-pure materials and composed of over 99% beta alumina crystals was developed specifically for this type of service.

Generally used in at least the heavy-duty zones of superstructure in the majority of glass tanks, the two high-alumina and zirconia-alumina products offer balanced tank life in these areas. The alpha beta alumina

(*Continued on page* 156)

TRANSMISSION OF RADIATION THROUGH GLASS IN TANK FURNACES

By B. S. KELLETT

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Editor's Note: THE GLASS INDUSTRY, in its February 1953 issue, reprinted a paper by Mr. Kellett, "The Steady Flow of Heat Through Hot Glass," which paper originally appeared in the *Journal of the Optical Society of America*. Mr. Kellett subsequently pointed out that he had written up his work on the flow of radiant heat through hot glass in two forms—one, primarily mathematical, mentioned above; the other, less mathematical and devoted chiefly to a discussion of the implications of the results for the glass-maker. This latter paper was published in the April 1952 issue of the *Journal of the Society of Glass Technology*.

Considerable interest has been shown in the subject matter. Therefore, THE GLASS INDUSTRY now presents the more practical version of Mr. Kellett's papers, with only the introductory and background portions in condensed form.

It is a common observation that the glass at the bottom of a glass melting tank is far hotter than might be expected from the fact that the heat is applied from above. Ordinary thermal conduction is not a sufficient explanation, for in a glass melting tank containing, say, sheet glass, the temperature gradient through the bottom block is much steeper than through the glass. But the thermal conductivity of the bottom block is roughly equal to that of the glass, so that the flow of heat by conduction is much greater through the bottom block than through the glass. This extra heat flowing through the bottom block must be supplied through the glass in some way other than by conduction.

It has been argued that radiation could not be of any importance because it was well-known that infrared energy falling on the surface penetrates only a few inches into even the clearest glass, so that no measurable amount could possibly reach the bottom of a tank three or four feet deep. Therefore, it was concluded that it must be convection currents that carry the heat to the bottom. This theory is difficult to accept if only because it offers no convincing explanation of the known dependence of bottom temperatures on the color of the glass.

F. W. Preston in 1947, however, pointed out that a proper treatment of the problem must take account of the fact that in absorbing the radiant energy incident on the surface of the glass, the first layer of the glass would itself become hot and therefore itself radiate energy. This energy would have the advantage of starting some distance down into the glass and would penetrate a similar distance again before it was absorbed. The layer that absorbed it would also become hot and radiate, and so the process would go on. The following mathematical section shows briefly how it is possible to calculate the magnitude of this effect.

It will be assumed that the same conditions hold over a reasonably wide horizontal area, so that the problem is one-dimensional, and radiation alone will be considered, neglecting conduction and convection. Then attention can be confined to a small element of the glass of unit horizontal area and of thickness dx, where x is the depth measured downwards from the surface. Radiation is falling on this element from neighboring elements above and below, some of which is absorbed and the rest transmitted. In addition the element itself radiates energy on its own account. Once stable conditions have been established, the element must take in by absorption the same amount of energy as it gives out by radiation.

Suppose R is the energy arriving from above per second, and S from below. Then R is made up of energy radiated by all the elements of glass above the one being considered. The energy emitted by those furthest away will have passed through a considerable thickness of glass before reaching the element being considered, and will have been heavily absorbed. That from nearer elements will have suffered only slight absorption. R therefore consists primarily of radiant energy emitted by elements fairly close to the one being considered. These will be at temperatures not very different from its own temperature Θ. R therefore contains the wavelengths associated with temperatures near to Θ, which means, for example, that if Θ is 1200°, the energy will lie mainly in the region of 2 μ. The same remarks apply to S.

To make any more progress, it is necessary to assume that the absorption coefficient a of the glass (defined so that a fraction e^{-at} is transmitted through a thickness t) is constant over the range of wavelengths concerned. Then the precise wavelength distribution of R and S does not matter, and it follows simply that of the total energy R the element of glass being considered will absorb $a\,dx\,R$ and transmit the remaining $(1-a\,dx)\,R$; and similarly for the energy, S, arriving from below. The emissivity of the element must be equal to its absorption $a\,dx$, so that the energy emitted by the element will be $a\,dx\,\sigma\Theta^4$ upwards and the same downwards, where σ is the Stefan-Boltzmann constant. The condition that the energy absorbed just balances that emitted therefore becomes.

$$a\,dx\,R + a\,dx\,S = 2\,a\,dx\,\sigma\Theta^4$$

$$\text{i.e., } R + S = 2\,\sigma\Theta^4$$

Also, in crossing the element, R loses $a\,dx\,R$ absorbed by the element, but is reinforced by $a\,dx\,\sigma\Theta^4$ emitted by the lower face.

$$\text{i.e., } dR = -a\,dx\,R + a\,dx\,\sigma\Theta^4$$

$$\text{i.e. } \frac{dR}{dx} = a(\sigma\Theta^4 - R)$$

$$\text{Similarly } \frac{ds}{dx} = a(S - \sigma\Theta^4)$$

$$\text{Subtracting, } \frac{d}{dx}(RS) = \Theta, \text{ so that } R - S = H, \text{ a constant, which is obviously the net downward rate of flow of energy.}$$

$$\text{Adding, } \frac{d}{dx}(R + S) = -aH$$

$$8\sigma\Theta^3 \cdot \frac{d\Theta}{dx} = -aH \text{ i.e., } H = \frac{8\sigma\Theta^3}{a} \cdot \frac{d\Theta}{dx}$$

In ordinary conduction, the thermal conductivity is defined as the ratio of the heat flow to the temperature gradient. This equation shows, therefore, that the radiation flow can be regarded as due to a "radiation conductivity" of $\frac{8\sigma\Theta^3}{a}$. This term has to be added to the ordinary thermal conductivity of any glass to give the total effective conductivity.

Independent consideration of radiation and conduction in this fashion is not legitimate when boundary conditions have to be satisfied. This approximate treatment therefore breaks down near the boundaries. A rough criterion is that the approximation is valid provided the glass is thick enough for only a negligible fraction of primary radiation falling on the surface to penetrate. It has been remarked already that about one part in 10^{13} would penetrate the full depth of sheet glass in a typical commercial tank, so that this approximate treatment is certainly valid in that case. For the same glass 12½ cm. deep in the experimental tank used by Halle and Turner, the direct transmission would be about 2 per cent, and the approximation is still reasonable. However, it cannot be applied freely to thin layers. The complete problem for any thickness of glass can be solved, but the mathematics is complicated and, because of the importance of the boundary conditions, no simple general formula can be given. For the purposes of this paper, however, it is accurate enough to regard the radiation heat flow as due to a "radiation conductivity" of $\frac{8\sigma\Theta^3}{a}$.

The next step is to make a more precise numerical estimate of this "radiation conductivity". The Stefan-Boltzmann constant, σ, is 1.37×10^{-12} cal./cm.^{2}sec. °K.^{4} A reasonable mean temperature for the glass in a sheet tank would be 1200°, so that $\Theta = 1473°$ Absolute. At 1200° the peak of the radiant energy is at about 2μ, so that a is to be interpreted as the absorption coefficient of the hot glass for wavelengths in the region of 2μ. The measurement must be made on hot glass because the absorption coefficient of a given glass at a particular wavelength varies with temperature. Reference has been made already to measurements showing that, for sheet glass at this temperature and wavelength, a is approximately 0.3 cm.$^{-1}$.

With these values for the symbols, the "radiation conductivity" becomes 0.117 cal./cm.°C. sec. This is about fifty times the ordinary thermal conductivity, and shows that certainly for sheet glass at 1200° the radiation heat flow is very important.

The form of the expression $8\sigma\Theta^3/a$ also shows how the importance of radiation depends on the temperature. As the temperature falls, Θ^3 falls rapidly. At the same time the radiant energy moves to longer wavelengths, where the absorption is in general greater.

The result is that the "radiation conductivity" falls even more rapidly than Θ^3. For example, at 500° a for sheet glass is probably about 5cm.$^{-1}$, giving a "radiation conductivity" of about 0.0014 cal./cm.°C. sec., which is only about two-thirds of the ordinary thermal conductivity. At room temperature the absorption coefficient must be interpreted as that in the region of 10μ, which is probably of the order of 10^4, giving a "radiation conductivity" of 3×10^{-8} cal./cm.°C. sec., quite negligible compared with the ordinary thermal conductivity. This rapid fall in effective conductivity with temperature agrees with the experimental work reported by G. V. McCauley in 1925 and with some recent measurements of thermal diffusivity by A. F. Van Zee and C. L. Babcock.

For the colored glasses the absorption coefficient can be expected to be greater than for clear glasses, giving a smaller "radiation conductivity" at a given temperature. So far there is no experimental information on the infrared absorption of colored glasses at high temperature, but estimates can be made from the known absorption at room temperature. It seems likely that the absorption coefficient of Calorex, for example, a heat-absorbing glass containing about 0.8 per cent Fe_2O_3, is about 6 cm.$^{-1}$ near to 2μ. This gives a "radiation conductivity" of 0.006 cal./cm.°C. sec. at 1200°, which is only one-twentieth that of sheet glass, and only about three times the ordinary thermal conductivity.

Practical experience and much experimental information, notably the laboratory tank measurements by Halle and Turner and Holscher and associates, are in terms of bottom temperatures and temperature gradients through glass in a tank. To make a comparison, the theoretical results for radiant heat transfer have to be translated into those terms.

Suppose heat is supplied to the glass in a tank at such a rate as to maintain the surface temperature of the glass fixed at, say, 1400°. Then the bottom temperature of the glass and the temperature gradient are determined by the fact that the flow of heat through the glass must equal the flow through the bottom and equal the loss of heat from the outer face of the bottom block. In symbols this can be expressed as follows:

$$\frac{K}{d}(1400 - \Theta) = \frac{K^1}{d^1}(\Theta - \phi) = L(\phi)$$

where K, d are the mean conductivity and depth respectively of the glass; K^1, d^1 are the same quantities for the bottom block; Θ is the bottom temperature; and ϕ the temperature of the outer face of the bottom block. $L(\phi)$ is the rate of loss of heat from the outer face, and is written in this form to emphasize that it is a function of the temperature ϕ. Within limits, the precise form of $L(\phi)$ does not seriously affect the calculated value of Θ. It will be good enough for present purposes to take $L(\phi)$ to be the loss from a blackbody at temperature ϕ to surroundings of about room temperature. That is, say, $L(\phi) = \sigma[(\phi + 273)^4 - 300^4]$. These equations can then easily be solved. Fig. 1 shows the solution for d = 100cm., $K^1 = 0.0025$ cal./cm. °C.sec., $d^1 = 25$ cm., corresponding to a typical full-size tank, as a function of the conductivity of the glass. The theory showed that the total conductivity, that is the sum of "radiation conductivity" and ordinary thermal conductivity, varies at 1200° from about 0.12 for sheet glass to about 0.008 cal./cm. °C.sec. for Calorex. According to Fig. 1, this should give rise in a full-size tank furnace with a surface temperature of 1400° to bottom temperatures ranging from about 1300° to 700°, and temperature gradients from about 1°/cm. to 7°/cm. This is in good agreement with practical experience, and shows that the radiation term can account for the high bottom temperatures found in practice with

comparatively clear glasses, and that the higher infrared absorption of colored glasses can easily be sufficient to account for the lower bottom temperatures experienced with them.

For a smaller tank such as that used by Halle and Turner for their experiments, d and d^1, the depth of glass and thickness of bottom block, are both different and the solution of the equations for the bottom temperature and temperature gradient has to be calculated afresh. This will lead to a different bottom temperature and a different temperature gradient for the same glass. The upper curve of Fig. 2 gives the same information as Fig. 1, but for the dimensions of Halle and Turner's laboratory tank, and shows that the temperature gradients are three to three and a half times those in the full-scale tank.

It seems from the literature that there has been a lot of misunderstanding about this point in the past. F. W. Preston assumed that the temperature gradients measured by Halle and Turner in their small laboratory tank would be reproduced in a full-scale tank, and because this would lead to an absurdly low bottom temperature for the full-scale tank, he concluded that convection currents must account for the difference. Halle compared temperature gradients in the small laboratory tank with those in commercial tanks and found the ratio of about three or four to one that this calculation predicts. He evidently did not fully appreciate the importance of the difference in dimensions, because under the title "commercial tanks" he grouped tanks ranging in depth from 18 to 42 inches without distinction. Holscher and his associates found laboratory temperature gradients two to three times full-scale, but were evidently at a loss to explain this. In fact, recalculating for the dimensions of their tank, which was somewhat larger than that of Halle and Turner, confirms that this is about the correct ratio. Finally, C. E. Gould tried to reconcile the observed model and full-scale temperature gradients by a non-linear temperature-depth relationship, tacitly assuming that the same temperature-depth relationship must apply regardless of the dimensions.

There seems to be present in all this work a prevailing misconception that temperature gradient is a physical property of a glass. It is not, of course. The temperature gradient depends not only on the glass but also on the dimensions and temperature of the tank in which the glass is melted. For this reason it seems unfortunate that the practice of measuring temperature gradients has grown up. It would be far better to measure conductivity as McCauley did, or thermal diffusivity in the manner of Van Zee and Babcock.

The gradients shown by the upper curve of Fig. 2, ranging from about 2½°/cm. for sheet glass to about 30°/cm. for Calorex are in good agreement with Halle and Turner's measurements. Their experiments also included tests with different surface temperatures, and the lower curve of Fig. 2 shows the theoretical effect of reducing the surface temperature to 1000°. The temperature at every point is reduced; in particular, the loss from the bottom is reduced and the temperature gradient is therefore reduced. For any given conductivity, the gradient is shown to be only about two-thirds of the value when the surface is maintained at 1400°.

There is an opportunity here to make another interesting comparison between the theoretical and the experimental results. Halle and Turner commented that their experimental temperature gradients seemed to be practically equal for any one glass for surface temperatures of 1000° and 1400°. They concluded that the "diathermanous characteristics" of the glasses did not change appreciably over that temperature range. A closer look at their curves shows that for most of the glasses, the gradient was steeper with the surface at 1000° than with the surface at 1400°, whereas at first sight, the opposite result would be expected. Only for the very darkest glass was the gradient shallower with the lower surface temperature. It is possible to give a qualitative explanation for this phenomenon. In passing from 1400° to 1000°, the change from the upper to the lower curve of Fig. 2 is accompanied by a considerable reduction in total conductivity of the glass because of the rapid fall in the radiation term with temperature. This results in a net increase in temperature gradient. The total conductivity of sheet glass, for example, falls from 0.12 to probably about 0.02 cal./cm. °C. sec. Only for the very darkest glass, for which the absorption coefficient is so large that the radiation term is never very great, is the reduction in total conductivity insufficient to cause a net increase in temperature gradient. These experimental results, then, are quite consistent with the theory, and incidentally with the conclusion of the theory that the total conductivity, which might be regarded as equivalent to "diathermanous charac-

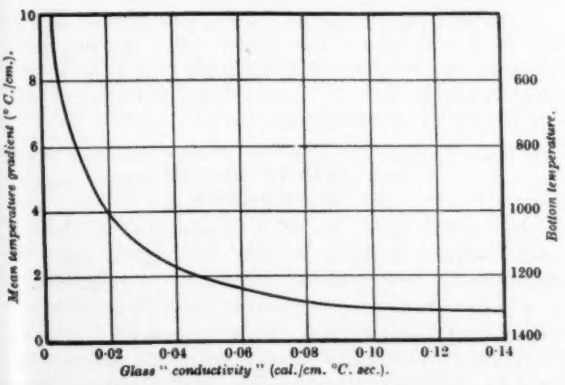

Fig. 1.

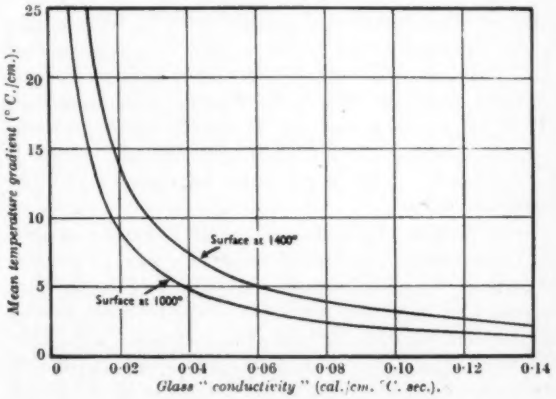

Fig. 2.

teristics", falls by a factor of five or more for sheet glass over this temperature range.

It would be unfair to claim that the theory outlined above is very accurate. A number of assumptions have been necessary, of which probably the least accurate is that the infrared absorption coefficient, a, of any glass is independent of wavelength over the range of wavelengths concerned. However, there is no doubt that the theory is accurate enough to have established, first that the radiation heat flow is very important, giving for sheet glass at 1200° a total conductivity about fifty times the ordinary thermal conductivity; and secondly, that the differences in infrared absorption among colored glasses can affect the radiation heat flow sufficiently to explain the very different heat transparencies of various colored glasses at melting temperatures.

Any more detailed application or verification of the theory must wait for more information on the high-temperature infrared absorption of colored glasses.

In the October 1953 issue of the *Journal of the Society of Glass Technology*, B. S. Kellett gives the following correction to his paper: The radiant energy given out in unit time by unit surface of a blackbody immersed in glass is $n^2\sigma\Theta^4$, where n is the refractive index of the glass. Throughout the paper, therefore σ, the Stefan-Boltzmann radiation constant, should be replaced by $n^2\sigma$. In particular, the "radiation conductivity" of a glass with absorption coefficient a at temperature Θ becomes $8n^2\sigma\Theta^3/a$ and not $8\sigma\Theta^3/a$.

Since this paper was published, others have appeared which calculate the "radiation conductivity" without the simplifying assumption of one-dimensional flow of radiant energy. The "radiation conductivity" is then shown to be $16n^2\sigma\Theta^3/3a$. With $n = 1.5$, this gives $12\sigma\Theta^3/a$. which is 50 per cent greater than the original result of $8\sigma\Theta^3/a$. The general conclusion that radiation is an important means of heat transfer through hot glass is, of course, strengthened.

1953 ANNUAL REPORTS

According to the annual report of Owens-Illinois Glass Company, the firm made sales amounting to $333,024,055.17 in 1953, which were up nearly 14 per cent over a year ago. Earnings were $16,267,385.90, or $5.32 per share. This compared with sales of $293,181,522.78 and earnings of $16,200,820.50, or $5.30 per share in 1952.

Record sales were reported by Libbey-Owens-Ford Glass Company in the amount of $212,490,726 which resulted in a net profit from operations of $19,233,667, equal to $3.72 per share. These operating earnings compared with $14,907,893, or $2.88 per share in the preceding year. Additional profits totalling $4,588,539 of a non-recurring and non-taxable nature resulted from special items, including the sale of the assets of the Plaskon Division at the depreciated value permitted for tax purposes, which was above book value, the latter having been substantially reduced by accelerated depreciation charges against earnings in prior years.

Sales of Diamond Alkali Company reached a record high of $86,734,279 in 1953, an increase of 13% over 1952. Earnings were $5,939,189, equivalent after preferred dividends to $2.39 per common share outstanding. This compared with earnings of $5,461,820, or $2.18 per common share in 1952.

Owens-Corning Fiberglas Corporation announced 1953 net sales of $131,744,657, including for the first time sales of subsidiaries now considered a significant part of the company's total business. This is an increase of 16% over sales of $113,400,920 on a comparable consolidated basis in 1952. Net income after taxes was $5,355,934 as compared with $5,082,772 for the previous year, an increase of only $273,162. The net income is the equivalent of $1.70 per share as against $1.61 per share for 1952.

In its annual report to stockholders, Ferro Corporation announced its consolidated net income for 1953 at 18% more than for the previous year. The preliminary summary of operating results for 1953 reflected Ferro's consolidated sales as $39,200,000, compared with $40,615,026 for 1952. Profit, after taxes, were $2.60 per share in comparison with $2.21 per share in 1952. Income from foreign subsidiaries and licensees totalled $644,994. The 1952 income from that source was $217,667.

The Hazel-Atlas Glass Company reported sales of $79,250,216 for 1953 as compared with $70,911,083 for 1952. Net earnings were reported to be $3,112,385 for 1953, while 1952 net earnings were $2,956,108.

The consolidated net income of The Carborundum Company and its U.S. and Canadian subsidiaries in 1953 was $5,721,553, equal to $3.69 per share, an increase of 19.6% over the $4,782,503, or $31.2 per share, earned in 1952. Sales volume of $82,927,005, a record high, exceeded 1952 sales of $70,173,250 by 18.2%.

C. L. RICE DIES

Clinton L. Rice, former Director of Purchasing for Owens-Illinois Glass Company and a veteran in the glass industry, died February 18 at his home following a brief illness.

Mr. Rice, who was 61, joined Owens-Illinois in 1930 when that company merged with the Graham Glass Company. He had been Vice President of Graham Glass and before that was with the American Bottle Company. Although most of his service with Owens-Illinois had been as Director of Purchasing, he had recently been handling special assignments for the company's Administrative Division and last year, in this connection, made a business trip to Australia.

Surviving are his wife, Ethyl; a son, Donald M. of St. Louis; a daughter, Mrs. Elaine Johns of Lexington, Kentucky; two sisters, Mrs. Gertrude Askey of Ponca City, Oklahoma, and Mrs. Leona Evan of Denver, Colorado; and three grandchildren.

AGA ELECTS BOARD OF GOVERNORS

Elected to serve on the Board of Governors of the American Glassware Association from January 1, 1954 to December 31, 1955 and thereafter until their successors have been elected are: *Governors at Large*, E. A. Donnan, President of Federal Glass Company, and W. L. Orme, President of Cambridge Glass Company. *Alternate at Large*, A. S. Taylor, Manager of the Lighting Sales Dept., Corning Glass Works.

GLASS CONSIDERED AS A POLYMER

By J. M. STEVELS

Philips Research Laboratories, N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands

PART II

II. The Thermal Polymerization of the Network

Peychès[2] has proved conclusively that, from the practical point of view, all glasses which have not been very carefully annealed will, especially in the outer layers but also in the interior, to some extent, exhibit the same structure as at the high temperature at which the glass was formed. Mainly those parts of the glass which are cooled rapidly reveal this condition. In other words, the network of such glasses is in fact not polymerized to the extent as would be permitted by the chemical composition. From the practical point of view—and here again it was Peychès who drew attention to the fact—all glasses are less dense than the case where it has been fully stabilized. This is revealed in particular by a lower refractive index, an increase in electrical conductivity and a number of other properties.

Let N_o be the number of chemical bonds in a block of glass which contribute to the coherence of the glass at very low temperature or, in other words, the maximum of bonds which is possible for a given chemical composition of the glass. Of these bonds, N_1 are effectively formed at a given temperature, N_2 broken at a certain moment as a result of thermal vibrations, and N_3 the bonds that might have occurred in the network but which incomplete fusion of the composition has left in a crystalline state.

We should then have:

$$N_o = N_1 + N_2 + N_3 \quad \ldots\ldots\ldots\ldots (6)$$

When during preparation a glass is incompletely melted, $N_3 \neq 0$. In general, N_2 is a function of the temperature (this temperature need not necessarily be that of the block itself, but may be the temperature which is "frozen in" in the glass itself in consequence of more or less sudden cooling). N_2 is therefore not a function of the temperature of the glass itself, but of the "thermal condition" thus conserved in the glass.

When formula (6) is applied to a piece of silicate glass containing ¼ gramme atoms of silicon ions, i.e., with ¼ R gramme atoms of oxygen, these network-forming ions have N bonds (N is Avogadro's number) of which $\frac{Y}{4}$.N contribute to the coherence of the glass at low temperatures. Let $\frac{Y}{4}$ or n_o be the maximum degree of coherence admissible from the chemical point of view; we can then write:

$$n_oN = n_1N + n_2N + n_3N,$$

where n_1 is the actual degree of coherence, n_2 the index of thermal depolymerization and n_3 the crystallization index. This gives us:

$$n_1 = n_o - n_2 - n_3, \quad \ldots\ldots\ldots\ldots (7)$$

in which $n_o = \frac{Y}{4}$. It is thus solely with stabilized fused silica in which no crystal formation has taken place that, at low temperatures, the degree of coherence $n_1 = 1 (Y = 4, n_2 = 0$, hence $n_1 = 1)$. In all other properly melted glass ($n_3 = 0$), a certain depolymerization is found at sufficiently low temperatures, attributable to the chemical composition ($n_2 = 0$).

Peychès uses a somewhat different nomenclature. He employs $\frac{N_1}{N_o}$ or $\frac{n_1}{n_o}$ for the degree of polymerization and, arising from this definition, an optical glass may have a polymerization degree of 1.

Our proposition permits of an easier comparison of the constitution or the networks of different glasses, and it is not improbable that networks with the same value of n_1 possess the same physical properties.

In order to determine n_1, we must first know n_o, n_2 and n_3. In general n_3 will be small, and it is probable that it could be determined easily by means of X-ray diffraction photography; n_o or $\frac{Y}{4}$ may be computed on the basis of the chemical composition. It is n_2 that entails the greatest amount of difficulty. It is a function which varies widely with the "frozen in" thermal condition, depending, moreover, although to a lesser degree, on n_o and probably also on the nature of the network-modifying ions in the glass.

We shall not dwell on this point. It is an established fact that the knowledge of n_2 as a function of the three quantities already mentioned, and thus also the knowledge of n_1, provides a means of describing the behavior of glass networks far more accurately than has hitherto been the case.

The diagram in Fig. 8 shows the relationship between the quantities n_1, n_2 (for a given value of $n_o = Y/4$ in the hypothetical case where $n_3 = 0$) as a function of the "frozen in" thermal condition. From this it will be seen that the value of n_2 increases all the more rapidly with the temperature as n_o becomes increasingly smaller,

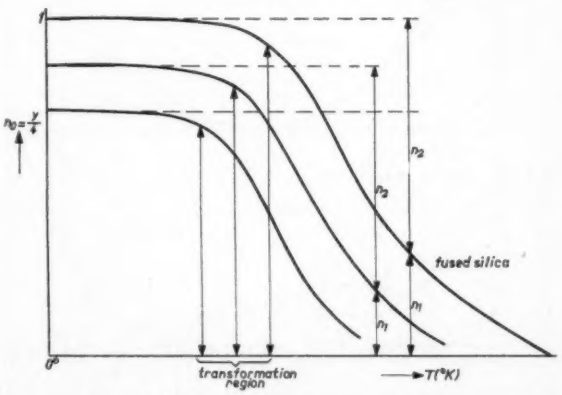

Fig. 8. Relationship between n_1, n_2 and the "frozen in" thermal condition T for a glass for which $n_3 = 0$.

and this is probably why the bend in the curves $n_1 = f(T)$ (a bend which approximately marks the transformation region) is displaced towards lower temperatures in the case of glasses having a lower n_0 (degree of coherence admissible from the chemical point of view).

III. The Vibrations of the Network Proper

Whereas we have so far considered mainly the degree of polymerization and depolymerization of the networks, we shall now see whether it is not possible to study these properties more or less direct with the aid of an external factor.

We shall take for this purpose the dielectric losses. The study of this quantity as a function of the temperature, frequency and chemical composition both in the United States and in Europe has become an important tool in the research into the structure of glass, and it is in this field that we should like to mention a few results of certain recent work directly concerned with a knowledge of the network proper.

We shall not dwell on the general theory of dielectric losses in glass, nor on methods of measuring these losses. We shall content ourselves with recalling that this quantity is generally represented by tan δ and that f. tan δ represents the fraction of the energy absorbed by the material per second when placed in an A.C. field of frequency f.

Figure 9, which represents the general form of the curve showing the dielectric losses in glass as a function of the frequency (full line) at two temperatures sufficiently far removed from each other, is self-explanatory. This general form has been analyzed to some extent[11], and it is found that there are four mechanisms which together form the spectrum of the dielectric losses. The result of this analysis is represented by the dotted lines on Fig. 9. Three of these mechanisms are directly related to the existence of mobile network modifiers. They are: (a) Conduction losses (curve 1, Fig. 9) arising from the propagation of the network-modifying ions throughout the glass; (b) Relaxation losses (curve 2) brought about by the propagation of the network-modifying ions over relatively short distances; (c) Vibration losses

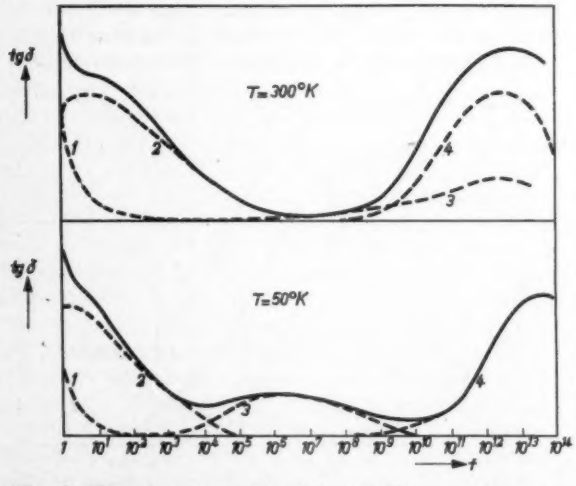

Fig. 9. Diagram of possible dielectric losses in glass, as a function of the frequency, at two temperatures which are sufficiently far apart.

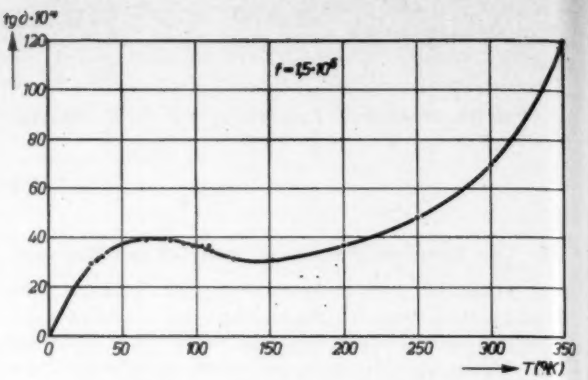

Fig. 10. Variation in the dielectric losses of Glass I as a function of the temperature at a frequency f = 1, 5 x 10^6 c/s. This figure has been published earlier in *Silicates Industriels 13*, 328 (1951) and in [11].

(curve 4) caused by the fact that the network-modifying ions are set in vibration about their own state of equilibrium by an external electrical field.

These three kinds of losses have been dealt with in numerous publications, and many theoretical considerations have been applied to them. In this paper and for our present purpose, however, they interest us but little. Figure 9 clearly shows how the losses vary according to the temperature. All this may be explained on physical grounds, but we shall not dwell on this point, which has already been discussed in detail.[11]

It has been known for many years that tan δ of glass when measured at medium frequencies, as a function of the temperature, passes through a minimum.[12] Obviously this fact cannot be attributed to phenomena related to the mobility of the network-modifying ions, as all such losses disappear at low temperatures.

The hypothesis has since been put forward that the network itself might contribute to the losses by producing the fourth type of loss, known as deformation losses. These losses, so it is thought, are due to the fact that certain portions of the network chains suddenly pass to another position. Quite logically, the relaxation time of such a phenomenon is extremely short.

The phenomenon exhibits the typical characteristics of a relaxation, and the general theory states that tan δ in this case is given by the expression:

$$\tan \delta = A \frac{\omega\delta}{1 + \omega^2\delta^2}, \quad \ldots\ldots\ldots\ldots (8)$$

where δ is the relaxation time of the phenomenon, ω the pulsation of the applied field ($\omega = 2\pi f$) and A a constant. At room temperatures for medium frequencies ($f \sim 10^6$ c/s) δ is very small when compared with the pulses since under these conditions $\delta \sim 10^{-12}$ secs.

Hence, in this case the losses are very small and they increase in proportion with the frequency, as indicated by curve 3 in the top of Fig. 9. The peak of the deformation losses is very difficult to ascertain because these losses are completely submerged in all the other losses, which, as we have seen, are due to totally different causes. In the top of Fig. 9, this maximum is indicated at a frequency of: $f \sim 10^{12}$ c/s.

All the same, when extremely low temperatures are applied (bottom of Fig. 9), deformation losses should be taken into account. At such low temperatures, the

vibration, relaxation and conductivity losses do certainly disappear at medium frequencies. The maximum deformation losses, moreover, are displaced towards the lower frequencies since the values of δ are of the order of 10^{-6} sec at these low temperatures. Deformation losses therefore occur at a high level. The lowering of the combined level of the other losses and a simultaneous rise in the "submerged" deformation losses make the latter apparent. It is logical, therefore, to study the deformation losses at frequencies of the order of $f = 10^6$c/s.

We shall content ourselves with mentioning the results of a few measurements. Figures 10 to 13 represent the dielectric losses of four types of well stabilized glass (I-IV) as a function of the temperature and at a frequency of $f = 1, 5 \times 10^6$ c/s. The rising part of the curve on the right-hand side represents the relaxation losses which have been known for a long time and which are due to the mobility of the network-modifying ions, whereas on the left-hand side, superimposed on the "tails" of these relaxation losses, the deformation losses are to be found. Although experiments have been carried out only up to 20 degrees K (measurements in liquid hydrogen), we have without hesitation interpolated the curves to 0°K, as it is certain that at this temperature all losses will have disappeared. We shall later revert to the position and the magnitude of the deformation losses.

The following question may arise, however: should the deformation losses be correctly attributed to sudden displacements of portions of the network chains, or rather to the jumps made by non-bridging oxygen ions? The answer is provided by studying fused silica. This glass affords exactly the same picture (Fig. 14) as the glasses previously mentioned and, as fused silica does not possess non-bridging oxygen ions, it is obvious that sudden displacements of portions of the chain should produce the deformation losses. This is confirmed by measurements on a quartz crystal. Since in this case we are concerned with a perfectly ordered lattice, the network will not therefore contain any portions of chains which might become displaced. Deformation losses will not occur at all. In fact, taking into account the measuring errors, it is found that all losses will have disappeared at 50°K.

Although we have thus substantiated the hypothesis that deformation losses are directly related to the network deformations, there are other facts to confirm this.

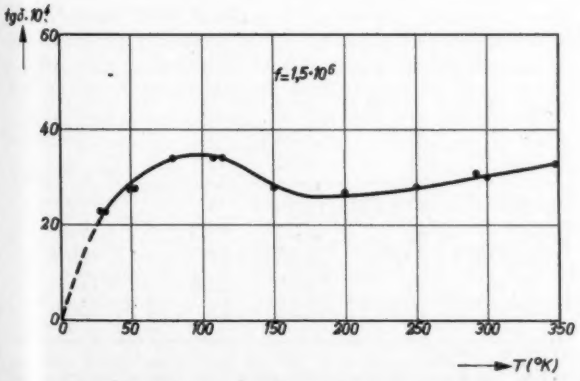

Fig. 11. Variation in the dielectric losses of Glass II as a function of the temperature at a frequency $f = 1, 5 \times 10^6$ c/s.

The number of detached portions increases as R increases or as Y diminishes and the portions themselves become larger. This implies that: (1) the deformation losses will increase; (2) the maximum will occur at higher and higher temperatures (the relaxation time of the jump phenomenon is in effect increased).

These results are fully confirmed by the curves. The magnitude of the deformation losses may be easily determined by subtracting the relaxation losses from the total losses. As already mentioned, the decrease in the network's coherence is shown by a decreasing value of Y. While for fused silica ($Y = 4$) only very slight defor-

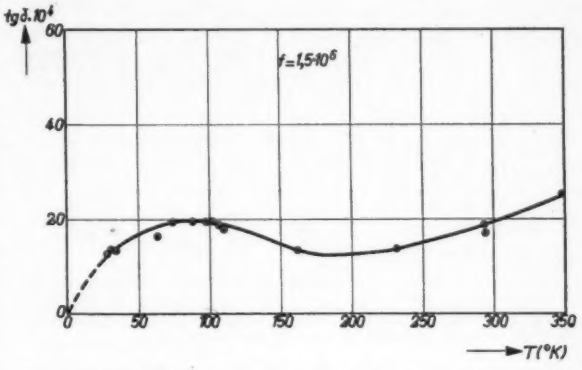

Fig. 12. Variation in the dielectric losses of Glass III as a function of the temperature at a frequency $f = 1, 5 \times 10^6$ c/s.

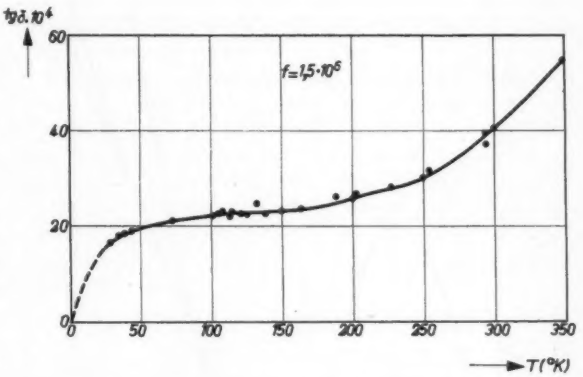

Fig. 13. Variation in the dielectric losses of Glass IV as a function of the temperature at a frequency $f = 1, 5 \times 10^6$ c/s.

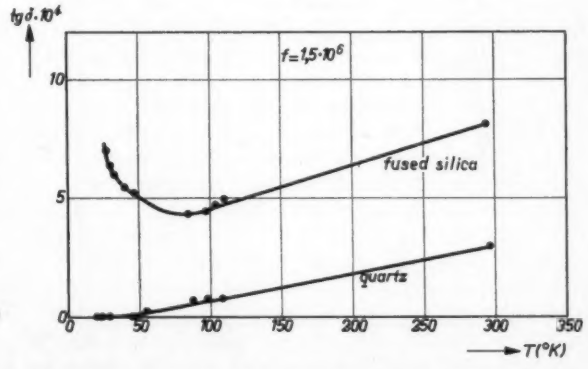

Fig. 14. Variation in the dielectric losses of fused silica and in a quartz crystal as a function of the temperature at a frequency of $f = 1, 5 \times 10^6$ c/s.

mation losses are found, with a maximum at very low temperatures (below 20°K), these two quantities increase as Y decreases. This rule is more or less independent of the network-modifying ions.

The data relating to glasses I to IV, fused silica and quartz, will be found in Table II.

Table II

	Y	Size of the peak of the deformation losses (tan δ .10⁴) at frequency f = 1,5.10⁶	Position of the peak of the deformation losses (°K) at frequency f = 1,5.10⁶
Glass I (Fig. 10)....	3,28	32	75
Glass II (Fig. 11)...	*	20	75
Glass III (Fig. 12)..	*	16	70
Glass IV (Fig. 13)..	*	13	40
Fused Silica (Fig. 14)	4	?	. <20
Quartz (Fig. 14)...	4	0	—

* The compositions of glasses II, III, and IV are so complicated (high B_2O_3 content, presence of "intermediate" ions) that a calculation of Y could be established only on doubtful hypotheses.

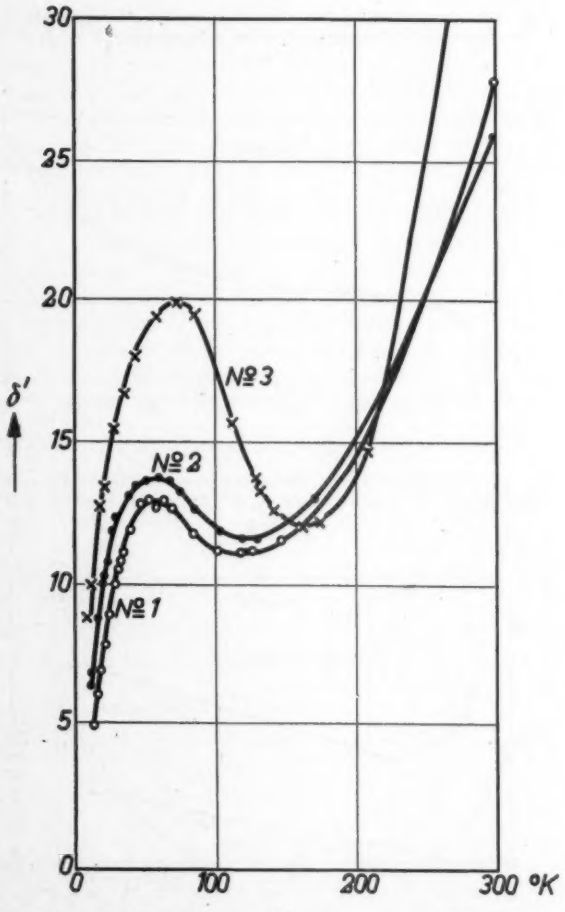

Fig. 15. Variation in the dielectric losses in the glasses 1 to 3 specified in Table III as a function of the temperature as a frequency f = 10⁶ c/s. Vide [13].

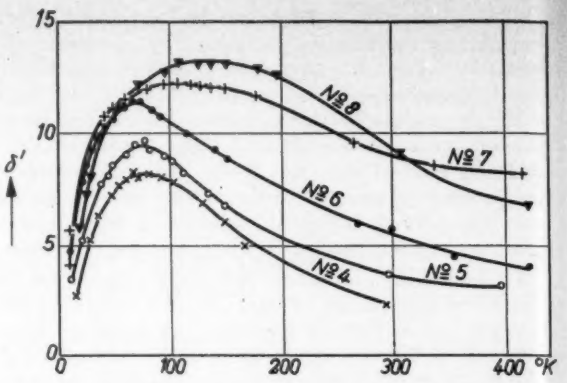

Fig. 16. Variation in the dielectric losses in the glasses 4 to 8 specified in Table III as a function of the temperature at a frequency f= 10⁶ c/s. Vide [13].

In this connection, certain Russian research work might be mentioned. Joffe[13] finds a similar behavior of dielectric losses in a glass at very low temperatures and a frequency of f = 10⁶ c/s, as is shown by Figs. 15 and 16 which are taken from his publications and which reveal a close analogy with our own.

Table III gives Joffe's values. These can be explained in the same way as those in Table II. Here the glasses mentioned have the advantage of not being complicated and of forming series whose composition has been changed gradually.

In recent years, the dielectric losses in glass have taught us a great deal about the structure of glass in general. We believe that we can affirm on the basis of previous experience, that the study of the network will especially be enabled to progress through measurements of the losses occurring at low temperatures. This field offers great scope, being still practically untouched as few have so far ventured into it, and then only with great hesitation.

In particular, the study of loose networks, as found in

(*Continued on page* 160)

Table III

Composition of glass in mole percentages	Y	Size of the peak of the deformation losses (tan δ .10⁴) at frequency f = 10⁶	Position of the peak of the deformation losses (°K) at frequency f = 10⁶
1) 82,7 SiO_2 –17,3 K_2O	3,58	8	64
2) 80,3 " –19,7 "	3,51	9	68
3) 77,3 " –22,7 "	3,41	15	75
4) 65,8 " –34,2 PbO	(2,96*)	8	72
5) 55 " –45 "	(2,36*)	9,5	76
6) 50,7 " –49,3 "	(2,05*)	11	80
7) 45 " –55 "	(1,55*)	12,5	115
8) 40,8 " –59,2 "	(1,14*)	13	130

* The calculated values of Y for the lead silicate glasses have no physical significance whatsoever, because a large part of the Pb^{2+} ions behave like network-forming ions. The values mentioned in the third column for lead silicates have not been corrected for the relaxation losses. It is certain, however, that the relaxation losses in this zone will be very small.

VENTILATION PROBLEMS IN THE GLASS AND CERAMICS INDUSTRY

By W. G. HAZARD, Director of Industrial Hygiene
Owens-Illinois Glass Company, Toledo, Ohio

Note: A film on "Industrial Ventilation", produced by the Michigan State Department of Health and American Air Filter Company, Inc., Louisville, Kentucky, was shown. This was followed by a demonstration, with discussion and questions.

This film "Industrial Ventilation" clearly brings out an important feature of local exhaust systems—but one over which there is still much confusion. Many people assume that because you can squirt a jet of air from a compressed air hose so its effect is felt many feet in front of the nozzle, you can "suck" air into an exhaust pipe from regions several feet away from the opening. This is perhaps the commonest pitfall of design when an inexperienced person lays out a dust exhaust system.

To emphasize this point, we constructed a simple model, not unlike the more elegant apparatus you saw in the movie, to drive the story home visually to our own plant people.

It consists of a two-foot section of ordinary sheet iron duct, six inches in diameter, mounted horizontally on a tripod. Inside the pipe is a small propeller-type fan which, when we turn the current on, draws air in one end of the pipe and blows it out the other. Obviously, all the air that blows out has to have entered through the other end.

At each end of the pipe, we have mounted rods extending about two feet beyond the ends. Pieces of tissue paper are hanging at six-inch intervals along the length of the rods.

You can see that the pieces of paper are blown almost horizontally by the air coming *out* of the pipe, but not even the piece of paper hanging nearest to the inlet end of the pipe (six inches away) is disturbed by the air *entering* the pipe. By using a smoke tube, we can trace the air currents even better. Just a few inches from the inlet end, air is stagnant, but the smoke is violently agitated several feet beyond the outlet end.

Thus it's impossible to "pick up" dust, or dust-laden air, more than a few inches away from an exhaust pipe. It has no magical power to reach out and suck in air from a local dust-producing operation. Air is not drawn from that isolated point to the exclusion of other points. It is drawn from the entire half sphere in front of the pipe, and from most of the half sphere behind the pipe. The velocity at any single point on this sphere is extremely low.

Dallavalle, Silverman, and others have worked out equations for finding the velocities along the centerline of a hood at various points out from the hood face. As an example, if we have an eight-inch round pipe with air flowing into it at a velocity of 4,000 feet per minute, the velocity at a point six inches away from the open pipe will be only about 500 feet per minute. A flange around the pipe opening keeps air from being drawn needlessly from in back of the opening, and permits the air flow rate to be reduced by 20 to 25 per cent of the open pipe requirements.

A simple rule of thumb is that when *exhausting*, the velocity at a point one diameter away from the pipe is 10 per cent of the face velocity; and when *blowing*, the velocity falls to 10 per cent of the face velocity at a point 30 diameters away from the pipe. Thus if our model (six inches in diameter) has air passing through it at 4,000 feet per minute, the velocity at a point *six inches* from the "sucking" end will be about 400 feet per minute, and the velocity will be 400 feet per minute at a point *15 feet* from the "blowing" end. Hence, it is extremely important, when exhausting dust from a local source, that this source be surrounded just as much as possible by the hood, baffles, or a booth for otherwise the contaminant won't get into the air stream and won't enter the piping.

Not related to dust exhausts, but to ventilation used for improving comfort in the hot industries, is the control of radiant heat. Man-cooling fans, and removal of hot air by diluting it with cooler outdoor air, are limited in their effectiveness when there are sources of radiant heat present.

This subject was discussed at the meeting of this Section last year. It is so important that some new developments should be mentioned. At least four exhibitors are showing *heat reflective* clothing. It is made of alumunized fabric and finds use when working around hot furnaces. We also have a film loaned by Minnesota Mining and Manufacturing Company, which illustrates how this type of material withstands radiant heat much better than ordinary non-reflective fabrics.

Presented before the 40th National Safety Congress, Glass and Ceramics Section.

FOOD MACHINERY & CHEMICAL OPERATIONS

Westvaco Chemical Division, with headquarters in the Chrysler Building East, New York City, will act as Sales Agent for the two newly-formed operating divisions of Food Machinery and Chemical Corporation—Westvaco Chlor-Alkali Division and Westvaco Mineral Products Division—it has been announced. Donald C. Oskin, previously Assistant Manager of Sales, Westvaco Chemical Division, has been appointed Manager of Sales.

Also announced is the appointment of Alfred T. Loeffler as Vice President of the Chemical Divisions of the corporation. Mr. Loeffler joined the firm in 1953 as Assistant Vice President.

Appointed Assistant Managers of Sales, Westvaco Chemical Division, were Arthur F. Smith and Preston F. Tinsley. Mr. Smith joined Westvaco in 1941. After representing the company in the New England and Ohio territories, he later became a divisional Sales Manager. Mr. Tinsley joined Westvaco in 1939. He was District Sales Manager in Charlotte until late 1941.

AMERICAN POTASH NAMES WESTERN DIVISIONAL SALES MANAGER

The appointment of Wm. M. Clines to the position of Western Sales Manager of the Heavy Chemicals Division of American Potash & Chemical Corporation has been announced by Wm. J. F. Francis, General Western Sales Manager.

Mr. Clines, who will have his headquarters in Los Angeles, will be responsible for the activities of the heavy chemicals sales force and product supervisors in that group, including those of borax compounds, potash, soda ash, salt cake, lithium, bromine chemicals and phosphoric acid.

Mr. Clines was formerly associated with the General Chemical Division of Allied Chemical & Dye Corporation, operating out of the firm's San Francisco and Chicago offices, and later served as District Sales Manager for that company in the Pacific Northwest and most recently in Southern California.

L-O-F ANNOUNCES NEW HIGH-DENSITY FIBER GLASS

Production of a new, high-density, compressed fibrous glass material with excellent shock and vibration-borne sound absorbing qualities has been started by the Fiber Glass Division of Libbey-Owens-Ford Glass Company.

According to Clinton F. Hegg, General Sales Manager of the company's Fiber Glass Division, the new material is already in use as instrument panel safety pads of many 1954 automobiles and as blower housings on air-conditioning units. Mr. Hegg said the new material absorbs and reacts to impact slowly and affords extremely effective shock protection and is an excellent thermal insulator. The compressed fiber glass, Mr. Hegg further stated, will not burn, mildew, rot, absorb moisture or odors and does not support the growth of fungi.

BALL-CIO SIGN THREE-YEAR PACT

Announcement has been made that Ball Brothers Company and the Federation of Glass, Ceramic and Silica Sand Workers of America, CIO, have extended their one-year labor contract into a three-year covenant that will not expire until October 1956.

The new three-year agreement extended the contract negotiated and signed last October which provided for an automatic wage increase of four cents an hour to become effective October 22, 1954; an automatic four-cents-an-hour increase to be effective October 22, 1955; and cost-of-living adjustments in accordance with an agreed-upon formula effective October 22, 1954 and again on October 22, 1955, provided the Consumer Price Index has risen or fallen.

The negotiations which led to the contract extension had been continuous since the signing of the 1953 contract. The contract signed in October provided a six-cents-an-hour wage increase and other fringe benefits.

GLASS FIBERS EXECUTIVE CHANGES

Announcement has been made that Faustin J. Solon, Jr., Vice President of Glass Fibers, Inc., has also been appointed Assistant to the President of the company in charge of public and trade relations.

In his new position, Mr. Solon will have full responsibility for development of the trade relations department, a new marketing function with the company. He will also continue previous public relations activities in civic affairs, stockholder relations, publicity and news bureau supervision. Mr. Solon has been with Glass Fibers since 1947 in merchandising, sales and advertising capacities.

It has also been announced that Robert V. McCallister has been appointed Sales Manager of the General Products Division of the firm. Mr. McCallister has been Manager of the New York sales branch.

In his new capacity, Mr. McCallister will supervise sales activities of the general products of the company, including lightweight thermal and acoustical insulation, quartz microfiber high temperature insulation and glass fiber packaging and cushioning materials. Before coming with Glass Fibers in September 1951, Mr. McCallister had been a sales engineer with the Electric Auto-Lite Company.

OWENS-CORNING APPOINTMENT

George P. Little, formerly administrative assistant to the Dean of the Harvard Graduate School of Business, has been appointed administrative assistant to Harold Boeschenstein, President of Owens-Corning Fiberglas Corporation.

A U. S. Navy veteran of World War II, Mr. Little was graduated from Rutgers University, where he was elected to Phi Beta Kappa, and the Harvard Business School.

OWENS-ILLINOIS APPOINTMENTS

The appointments of Robert Creed and Henry M. Powell, Jr., as salesmen for the Owens-Illinois Glass Company's Glass Container Division have been announced by Sidney F. Davis, Division Vice President and General Sales Manager.

Mr. Creed, a graduate of the University of North Carolina, has been assigned to the Memphis branch. He joined the company two years ago as a field representative for prescription container sales. Mr. Powell has been assigned to the New Orleans branch.

REPORT ON G.B.B.A. MID-WINTER MEETING

Wide approval from both labor and management has greeted the recent ratification by the AFL Glass Bottle Blowers Association of the AFL-CIO "no raiding" pact, it was reported by Lee W. Minton, President of the G.B.B.A. at its mid-winter meeting.

In a statement commenting on the ratification, Mr. Minton said, "We believe industrial harmony can be served best by peace within the ranks of labor by using our energies to organize the unorganized, rather than raiding a rival union, which has never been the policy of our organization." A $200,000 fund was budgeted to organize non-union workers in G.B.B.A.'s jurisdiction.

Inventions and Inventors

Feeding and Forming

Temperature Control for Glassworking. Patent No. 2,658,687. Filed January 9, 1948. Issued November 10, 1953. One sheet of drawings (none reproduced). Assigned to Corning Glass Works by George H. Southworth.

The present invention relates to equipment for maintaining a glassworking implement, such for example as a plunger or mold of an automatic glassworking machine within a desired temperature range. It is particularly concerned with the provision of facilities for rapidly cooling such an implement during each working cycle to abstract an amount of heat substantially corresponding to that absorbed by the implement from the hot glass during the working cycle. By such facilities, the implement may be maintained at its best working temperature range. By close control of temperature, the implement can be operated at a higher average temperature than ordinarily considered practicable. This is of particular advantage when it is desired to press articles of minimum wall thickness as there is less initial chilling of the glass by the higher temperature implement when the charge of molten glass first comes in contact with the implement.

The temperature control is maintained by supplying a gaseous cooling fluid under pressure to the interior of the mold or plunger. The amount of cooling fluid is controlled by a temperature controlled valve which provides the proper heat exchange.

The patent contains 5 claims and 12 references were cited.

Furnaces

Furnace for Electrically Melting Glass. Fig. 1. Patent No. 2,659,764. Filed January 29, 1951. Issued November 17, 1953. Two sheets of drawings. Assigned to Mitterberger Glashuetten Gesellschaft m. b. H. by Walther Konig.

In the electrical melting of glass, there is a narrow marginal region of much colder glass that frequently leads to inhomogeneous glass, chords, striae, etc. In order to offset this difficulty to electric melting, shorter auxiliary electrodes are provided opposite each main electrode on the longitudinal sidewall of the furnace. They are connected to the same pole or phase of the current source.

In Fig. 1, main electrodes are provided, which extend toward the opposite sidewall only a small distance beyond the center of the tank. The main electrodes of the right-hand wall are designated with 6, 6′, and 6″, the main electrodes of the left-hand wall with 7, 7′, 7″, and 7‴.

Auxiliary electrode 13, 13′, etc., and 14, 14′, etc., respectively, are provided opposite each main electrode, and connected to the same terminal of the source of current as the latter. These auxiliary electrodes do not extend to the center of the tank but project inwardly only to that extent which is required to generate the amount

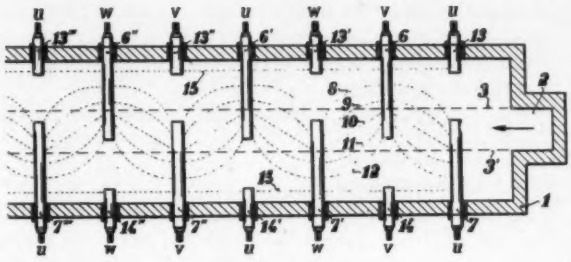

Fig. 1.

of heat required to compensate the cooling effect of the sidewall bricks. Thus, in addition to the flow lines 8 to 12, flow lines 15 are set up between each main electrode and the adjacent side electrode so that the heat loss through the sidewalls is compensated.

The extent to which the auxiliary electrode 13 should project into the tank interior depends only to a very slight degree on the internal width of the tank because the function of the electrode consists in heating the marginal region of the tank. When the said extent is less than about 8 inches, the required flow lines cannot form, whereas they are situated too far from the wall when the extent is more than about 20 inches. The heating of the marginal portion of the tank can be controlled by the sliding adjustment of the auxiliary electrodes.

The patent contains 10 claims and the references were as follows: 1,610,377, Hitner, Dec. 14, 1926; 2,350,734, Dumarest, June 6, 1944; 2,552,395, Borel et al., May 8, 1951; 28,536, Great Britain, of 1910; 247,120, Switzerland, Nov. 17, 1947; 489,207, Great Britain, July 21, 1938; 498,379, Great Britain, Jan. 6, 1939; and 600,268, Great Britain, Apr. 5, 1948.

Combined Electrode and Skimmer for Electric Glass Melting Furnaces. Fig. 2. Patent No. 2,658,094. Filed May 10, 1950. Issued November 3, 1953. Three sheets of drawings. Assigned to General Electric Company by Gordon C. Nonken.

It is the object of this invention to provide a combined electrode and skimmer which provides improved features, both as an electrode and as a skimmer. The furnace 10, as shown in Fig. 2, comprises two compartments—a first compartment 12 in which the raw materials are placed for melting and a second compartment 13 from which the molten glass is withdrawn. The two compartments are separated by skimmer and electrode 11 which comprises a flat rectangular member 14 of an electrically conductive heat resistant material such as molybdenum and a double tubular portion comprising hollow tubes 15 and 16 which are made of an electrically conductive heat resistant material which does not readily corrode in air at high temperatures, such as some steel alloys. Tube 16 and plate 14 are solidly joined along their common junction 17, while tubes 15 and 16 are likewise solidly joined along their abutting surfaces.

The electrode and skimmer 11 is positioned closely adjacent the end of the chamber 12 from which chamber 13 projects and forms a barrier so that molten glass in order

to flow from chamber 12 to 13 must pass beneath member 14. Member 11 thus serves as a skimmer and prevents impurities and incompletely melted glass, which is lighter than completely melted glass and thus floats on it, from entering chamber 13. Electrical connections (not shown) are provided to apply a potential between skimmer and electrode member 11 and a second electrode 20 at the opposite end of chamber 12 in order to pass current through the molten glass and raw materials in chamber 12 and thereby heat them.

The patent contain 4 claims and 16 references were cited.

Glass Compositions

Neutron Absorbing Glass. Patent No. 2,660,532. Filed January 29, 1952. Issued November 24, 1953. No sheets of drawings. Laben M. Melnick, Hurd W. Safford, Kuan-Han Sun and Alexander Silverman.

Heretofore the common practice has been to use such opaque materials as thick concrete blocks, metallic cadmium or boron steels for neutron shields. The disadvantages of such materials are well known, especially the inability to see beyond the shield.

It is the object of this invention to provide glasses for absorbing neutrons, especially of the slow or thermal type, which may be made from readily available and relatively inexpensive ingredients. They also may be melted easily by ordinary glassmaking procedures and are of adequate chemical durability, and are colorless or only slightly colored.

Glasses composed of about 1 to 67 per cent of cadmium oxide (CdO), from about 40 to 0 per cent of boron oxide (B_2O_3 or $BO_{1.5}$), and from about 6 to 28 per cent of silica (SiO_2) are desirable. Also about 8 to 29 per cent of calcium fluoride (CaF_2) is used to render the melting easier.

The batches were melted at 1250°-1400°C. When the melts were homogeneous, the glasses were poured into stainless steel molds preheated to 500° to 550°C., and finally annealed. The resulting glasses ranged from a pale yellow color through a pale green to colorless.

The patent contains eight claims and the following references were cited: 2,435,995, Armistead, Feb. 17, 1948; 2,439,192, Sun et al., Apr. 6, 1948; 2,511,517, Spiegel, June 13, 1950; 2,517,459, Armistead, Aug. 1, 1950; 2,523,362, Fraser et al., Sept. 26, 1950; 2,584,974, Armistead, Feb. 12, 1952; 2,584,975, Armistead, Feb. 12, 1952; 2,606,841, Armistead, Aug. 12, 1952; and Serial No. 395,364, Berger et al. (A.P.C.), published May 11, 1943.

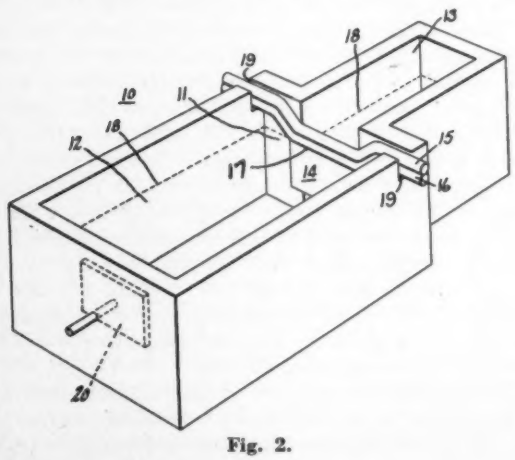

Fig. 2.

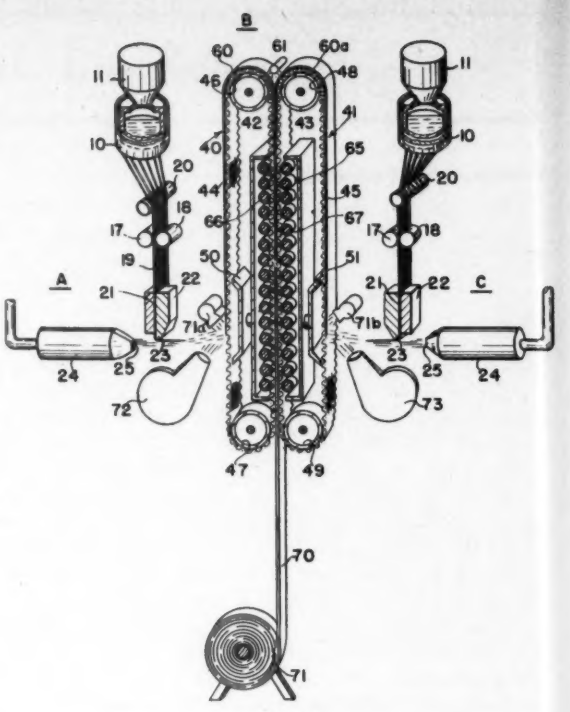

Fig. 3.

Method of Producing Glass Plaques. Patent No. 2,658,311. Filed February 7, 1951. Issued November 10, 1953. One sheet of drawings (none reproduced). Charles H. Goddard.

This invention relates to a glass plaque having a photographic image in depth therein, and to devices using such plaques. The object of the invention is to produce a plaque which does not require a separate back reflector or refractor, but in which the reflector or the like is part of the plate itself.

To produce the ceramic reflecting coating, the glass can be first coated on the desired side with, for example, 96 parts by weight of ground glass frit and 4 parts by weight of titanium dioxide pigment, nine parts of this by weight being suspended in 48 parts by weight of 91% isopropanol and 9% water. One-tenth part of polyoxyethylene sorbitan monolaurate is added to the suspension.

The photographic glass can be the copper-containing glass of the Dalton patents 2,326,012 and 2,422,472. To develop the latent image, the glass should be heated to about its softening point.

The patent contains one claim and the references cited were as follows: 2,194,611, Paddock et al., Mar. 26, 1940; and 2,326,012, Dalton, Aug. 3, 1943.

Glass Wool and Fiber

Manufacture of Glass Paper. Fig. 3. Patent No. 2,658,848. Filed November 17, 1951. Issued November 10, 1953. One sheet of drawings. Assigned to Glass Fibers, Inc., by Dominick Labino.

This invention relates to methods and apparatus for producing as a new article of manufacture a glass paper. An object of this invention is to provide a method and

apparatus for producing paper from glass fibers, and particularly to produce paper having good tensile strength and which will have uniform physical, electrical and chemical characteristics. The apparatus is shown in Fig. 3.

Glass fiber formed by the fiber forming unit "A" is deposited on the outer run 44 of the belt 40 while the glass fiber from the fiber forming unit "C" is deposited on the outer run 45 of the belt 41. As the composite web moves downwardly between the runs 42 and 43 of the wire fabric belts, the web is carried into a heating chamber 65 that is provided with any suitable heating means. Within the heating chamber 65 there is provided a series of rolls 66 against the run 42 of the belt 40 and the corresponding series of rolls 67 against the run 43 of the belt 41. These rolls 66 and 67 retain the runs 42 and 43 of the wire fabric belts in predetermined space relationship to compress the web carried between the runs of the belts and establish a web of predetermined thickness discharging from the heating chamber 65 as a dry web which is then usable as paper. The finished web 70 is wound into a supply roll 71.

The patent contains two claims and the following references were cited: 2,188,373, Pearce, Jan. 30, 1940; 2,332,290, Callander, Aug. 14, 1945; 2,489,242, Slayter et al., Nov. 22, 1949; 2,491,761, Parker et al., Dec. 20, 1949; 2,564,882, Cubberley et al., Aug. 21, 1951; and 2,571,334, Browne, Oct. 16, 1951.

Paper Reinforced with Glass Yarn. Patent No. 2,653,090. Filed May 13, 1948. Issued September 22, 1953. One sheet of drawings (none reproduced). Assigned to Mosinee Paper Mills Company by Henry C. Crandall.

Reinforced paper having improved characteristics may be produced by incorporating strands of glass yarn coated with a thermoplastic resin binder within the body of the paper. The reinforcing materials consist preferably of a plurality of very fine diameter glass fibers twisted into strands. The diameter of these strands is normally less than 1/32 of an inch.

To secure adhesion between the glass fibers themselves and between the glass strands and the paper fibers, the glass strands are coated and impregnated with a thermoplastic resin. The thermoplastic resin to be utilized is preferably a thermoplastic alkyd resin, a coumaroneindene resin, a rosin ester or a hydrogenated rosin.

Paper reinforced with glass yarn is said to possess a very high tensile strength with a relatively smooth surface, and offers considerable advantages over conventional paper reinforced with jute, silk, cotton and the like.

The patent contains four claims and 19 references were cited.

Sheet and Plate Glass

Electrically Conducting Laminated Glass. Fig. 4. Patent No. 2,650,976. Filed March 21, 1951. Issued September 1, 1953. Five sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Romey A. Gaiser and James H. Boicey.

Electrically conducting laminated safety glass is a relatively new development and is similar in construction to ordinary laminated safety glass except that one of the glass sheets has an electrically conducting coating on an inner surface shown in Fig. 4. In order to render the completed unit electrically conducting, the glass panel 21,

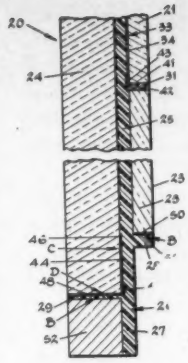

Fig. 4.

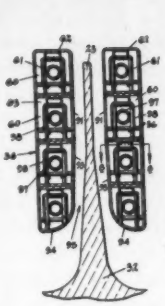

Fig. 5.

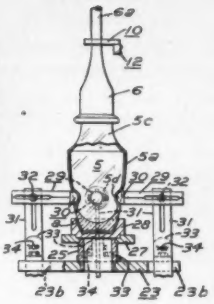

Fig. 6.

which becomes the outboard light in the plane, is provided, prior to laminating, with suitable electrodes 32 (not shown) along two opposite marginal portions of the inner surface 33 and with an electrically conducting coating or film 34 on this same surface. A number of different materials may be used for the electrodes 32 and they may be applied to the glass in any convenient manner. For example, electrodes of sprayed copper, sprayed copper alloys, copper foil, silver and platinum fluxes and combinations of these materials have all been used satisfactorily.

According to one preferred method of applying the electrodes 32 and the electrically conducting film 34 to the glass panel 21, the two opposite marginal portions of the panel's surface 33 are first sprayed with an electrically conducting silver flux and then heated to fuse the flux onto the glass. The electrodes thus formed may then be electroplated with copper to permit the soldering of suitable and necessary leads thereto.

With the electrodes 32 in place, the panel 21 is then ready to be filmed and this step may be accomplished by first heating the panel to approximately the softening point of the glass and then spraying the surface 33 with a solution of stannic tetrachloride to deposit a clear, transparent electrically conducting layer of tin oxide 34 on the glass over, and in contact with, the electrodes 33.

The filmed glass panel 21 is now properly prepared to be incorporated into an integral composite structure by, first, assembling it together with the panels 22, 23 and 24 and the necessary plastic elements to form the plastic body 26, which includes the interlayer 25, and then laminating the several layers of the assembled glass-plastic sandwich together, under heat and pressure, in accordance with any of the well-known laminating procedures.

When this has been done an electrically conducting laminated glass unit, which is stable and entirely satisfactory when tested in the laboratory under ambient temperature conditions, is obtained. A complete understanding of this lengthy patent can be obtained only after a careful study of the many drawings.

The patent contains 14 claims and the references cited were as follows: 2,282,441, Whitlock, May 12, 1942; 2,490,433, Gunning et al., Dec. 6, 1949; 2,507,036, McCrumm et al., May 9, 1950; and 2,513,993, Burton, July 4, 1950.

Apparatus for Forming Sheet Glass. Fig. 5. Patent No. 2,655,765. Filed November 6, 1947. Issued October

20, 1953. Four sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Emmett L. Walters.

This invention relates broadly to the production of sheet glass, and more particularly to an improved method and apparatus for controlling the temperature of the glass sheet and of the surrounding atmosphere while the sheet is being drawn from a mass of molten glass.

Fig. 5 is a plan view of a portion of the draw pot showing the relative locations of the multicompartment coolers with reference to the sheet of glass.

Edge coolers 36 are positioned relative to the sheet 23 of glass in order that the radiant cooling influence of their adjacent surfaces may be directed against the outer edge portions as the sheet assumes the desired final thickness. The coolers 36 comprise a series of superimposed compartments 60 having conduits 61 and 62 that are supported by welding in a plate 63 which closes the end of each compartment. The conduits are connected by suitable piping to a source of fluid temperature control medium or coolant which supplies the fluid at the desired temperature. The controlled temperature gradient supplied by the coolers conditions the glass as it is drawn and provides a sheet with little distortion and waves.

The patent contains two claims and 22 references were cited.

Tube and Cane Machines

Sealing of Cathode-Ray Tubes. Patent No. 2,656,650. Filed November 20, 1951. Issued October 27, 1953. Two sheets of drawings (none reproduced). Assigned to The Rauland Corporation by John F. De Ano.

A cathode-ray tube comprises two major sub-assemblies which are usually fabricated separately and joined together only in a later stage of the manufacturing process. One of these sub-assemblies is the outer shell, or envelope, of the tube; the other is the electrode system, or electron gun.

The invention provides apparatus for sealing such assemblies. It includes a plurality of operating stations, each having at least one localized heat source, arranged in predetermined sequence for subjecting the envelopes to a predetermined heat-treating cycle. A thermally sensitive device is operatively connected to the temperature-indicating device and fixed to the support member in such a position that it registers the heat treating temperature at the particular operating station momentarily occupied by the workholder in which the support member is currently installed. Precise determination of the temperature at each operating station in the sealing and annealing process is essential to prevent losses which might otherwise result from flaws due to improper maintenance of the heat-treating cycle.

The patent contains eight claims and the references cited were: 1,563,104, Pedersen, Nov. 24, 1925; 2,058,880, Hunt, Oct. 27, 1936; 2,237,186, Malloy, Apr. 1, 1941; 2,418,763, Eisler, Apr. 8. 1947; and 2,434,664, Malloy, Jan. 20, 1948.

Ampul Cutter. Patent No. 2,655,767. Filed April 20, 1950. Issued October 20, 1953. Two sheets of drawings (none reproduced). Assigned to H. R. Stallbohm by Edward F. Wenner.

This invention relates to apparatus for removing a neck from a glass vessel, and more particularly to a cutter for opening an ampul of the type which is hermetically sealed to hold a solution for hypodermic injection or the like. It comprises a small, lightweight container having means to receive and hold an ampul with the neck in a raised position, so that when the neck is removed the liquid level will be below the breaking point. A cutting element in the form of a scribe is provided for scoring the neck of the ampul. There is also provided a hammer for snapping off the neck of the ampul after the neck has been scored. A tape of absorbent material is used, in conjunction with a supply of disinfectant, to provide for cleaning the surface of the neck in the area where the break is to be made to prevent contamination of the ampul contents.

The patent contains 10 claims and the following references were cited: 1,522,271, Rippl, Jan. 6, 1925; 1,805,369, Merck, May 12, 1931; 2,447,988, Pierson, Aug. 24, 1948; 2,494,674, Smith et al., Jan. 17, 1950; 287,172, Great Britain, 1928; and 405,078, Germany, 1924.

Miscellaneous Processes

Dimpling Apparatus for Hollow Parisons. Fig 6. Patent No. 2,655,766. Filed November 7, 1951. Issued October 20, 1953. Three sheets of drawings. Assigned to Morgantown Glassware Guild, Inc. by Joseph R. Haden.

The object of the above invention is to provide apparatus for producing uniform dimples or pinch effects in glasses, goblets and steamware.

In Fig. 6 dimpling fingers 29 are simultaneously advanced into contact and pressing-in engagement with sidewall portions 5a of the parison. The dimpling fingers are provided with rounded carbon tip ends 30. The fingers 29 are arranged to provide diametrically-opposed pairs and they complete their pressing-in operation on a transverse or horizontal plane which is at right angles or perpendicular to the longitudinal or vertical axis of the parison 5. It is highly important that the rounded tips 30 of the fingers 29 end or complete their operation on such a plane.

The type of inward and outward movement of the fingers effects an insetting or dimpling operation that assures an absolute accuracy of the operation (which is essential in smaller sizes of hollow articles) and dimples that are fully symmetrical. The dimples not only give a highly pleasing ornamental effect, but provide positive finger grips for holding the article.

The patent contains five claims and the references cited were as follows: 283,625, Locke, Aug. 21, 1883; 635,392, Ruhe, Oct. 24, 1899; and 2,512,781, Stewart, June 27, 1950.

Process and Composition for Washing Glass. Patent No. 2,656,289. Filed January 21, 1949. Issued October 20, 1953. No sheets of drawings. Assigned to Kelite Products, Inc. by Dariel E. Miller.

This invention relates to a process and composition for washing glass to remove siliceous scale. It is dependent on the discovery that potassium fluosilicate K_2SiF_6 in an acid solution is both effective to remove siliceous scale from glass surfaces, but also may be applied to glassware without harmful effect on the glass surface. The glassware is unaffected and remains unpitted or etched after many prolonged treatments with the acid solutions of the potassium fluosilicate preparation.

A recommended composition consists of 20 parts

(*Continued on page* 161)

Research Digest

Some Factors in Glass Tank Operation and Design

The basic function of a glass tank is to deliver homogeneous glass at a certain required viscosity to one or more machines. To reach this goal, F. L. Bishop in the June 1953 issue of the *Bulletin of the American Ceramic Society* discusses the physical properties of the glass and the physical features desirable in each portion of the tank.

Since the forming machine requires glass of a certain viscosity, the temperature at which any specific glass has this viscosity is a fixed point of importance. The factor which limits temperature on the low side is the liquidus temperature. As a general rule the glass must never go below the liquidus temperature. The difference between these two temperatures determines how close the control must be.

Another property of the glass of great importance in tank design is heat absorption. This property is partially responsible for determining the vertical temperature gradient. The direction and amount of flow and natural and forced convection play a large part also.

Results of cerium tests indicate that it is necessary to flow into the machine pit several times the quantity of glass to be drawn. This is logical when we consider the different conditions in neighboring parts of the tank. We want to draw from a large supply of glass all of which has the same recent thermal history. There are a large number of unknown and unproved factors but certain conditions can be set down for the manufacture of good glass.

(1) The melting section must be large enough to melt and refine the amount of batch and cullet required. The depth of this section of the tank is determined by the temperature gradient. In general, it should be as deep as possible to permit greater mixing. Vertical currents in the tank, like horizontal currents, are determined by the temperature gradient and these vertical currents mix the glass and sweep the bubbles of gas out. This depth is also required to protect the bottom from high temperatures with consequent erosion. Temperatures in this section will be discussed later.

(2) The so-called refining section of the tank is the section about which least is known. This should be called the homogenizing section since it is here that turbulent convection currents stir the glass and where its temperature is reduced gradually. Because so little is known about this section, it will be considered along with (3).

(3) The conditioning section is where the glass is brought to the proper forming temperature and presumably the flow is streamlined. In order to study the combination of factors which influence the glass flow, these have been separately calculated and then combined in what we have called a "point velocity curve".

In a recent article on "Convection Currents in a Glass Tank", I. Peyches starts with the elementary theory of heat convection currents in a liquid and develops equations for use in calculating the flow of glass in a tank.

Table I

Worksheet for "Point Velocity" Graph

Dist. l	θ	dθ	dθ/dl	L	h³	Lh³	Log η	η	Lh³ dθ/dl	Lh³/η	dθ/dl
0	2480			32	111	3552					
3	2518	—38	—12.7				1.880	76	—45,110	—595	
6	2544	—26	— 8.7				1.830	68	—30,900	—454	
9	2566	—22	— 7.3				1.787	61	—25,930	—425	
12	2584	—18	— 6.0				1.750	56	—21,310	—380	
15	2600	—16	— 5.3				1.720	52	—18,830	—362	
18	2615	—15	— 5.0				1.695	49	—17,760	—363	
21	2630	—15	— 5.0				1.665	46	—17,760	—386	
24	2642	—12	— 4.0				1.645	44	—14,210	—323	
27	2648	— 6	— 2.0				1.635	43	— 7,104	—165	
30	2645	+ 3	+ 1.0				1.640	44	+ 3,552	+ 80.7	
33	2637	8	2.7				1.655	45	9,590	213	
36	2624	13	3.3				1.675	47	11,720	249	
39	2602	22	7.3				1.720	52	25,930	499	

Using this work, we define a surface or point velocity A as

$$A = \frac{Lh^3}{\eta}\frac{d\theta}{dl}$$

Where

L = width
h = depth
$\frac{d\theta}{dl}$ = temperature gradient along the flow path
η = viscosity

This value A probably cannot be defined in terms of an actual physical quantity. $\frac{h^3}{\eta}\frac{d\theta}{dl}$, when multiplied by a constant to take care of the units used, is what the velocity of a point on the surface of the glass would be if it were not influenced by the glass ahead or behind it. It might be called a velocity tendency at a point. Since we are primarily interested in amount of glass, this has been multiplied by the width, giving an area velocity. It is then the amount of surface area that would pass this point in the tank if not influenced by glass ahead or behind. In a section of the tank where the flow is uniform, this value should be proportional to the amount of glass flowing.

All this is tantamount to saying that the amount of glass flowing is directly proportional to the width of the tank, to the temperature gradient along the tank, $\frac{d\theta}{dl}$, and to the cube of the depth. It is inversely proportional to the viscosity.

Table 1 shows the method of calculation used. The data may be plotted on rectangular coordinate paper, but for several reasons semilogarithmic paper is preferable.

(1) The differences between different tanks are so great that the scale must be changed if rectangular coordinates are used.

(2) Since the scale is the same for all curves on semilogarithmic paper, a direct comparison of the flow rates can be made at a glance.

(3) Use of rectangular coordinates loses the detail of the curves toward the forming end where values are small.

(*Continued on page* 158)

TOLEDO ENGINEERING MOVES TO MODERN, EXPANDED QUARTERS

Toledo Engineering Company has moved into its new ultra-modern and engineering department quarters at 3001 Sylvania Avenue, Toledo. Custom-planned by Sanzenbacher, Morris and Taylor, Toledo architects and engineers, the new building is complete in every detail. Year-round air conditioning, special lighting and acoustical walls and ceilings are a few of the many features.

The finest in office and drafting equipment is now in use, and company officers are now in a more desirable position than ever to handle all phases of glass and lime plant design and construction.

The Toledo Engineering Company, Inc., was founded in 1929 by George W. Batchell and incorporated under its present name. The Arnold Weigel Company, pioneers in the field of lime plant design, including lime kilns, rock crushing and screening plants and lime hydrators, was acquired in 1949. Following the acquisition, Mr. Weigel has remained as General Manager.

LACLEDE-CHRISTY APPOINTS GENERAL SUPERINTENDENT

Laclede-Christy Company has announced the appointment of G. A. Fuchs as General Superintendent, Fire Brick Division.

Mr. Fuchs will be responsible for the operation of all of Laclede-Christy fire brick and silica plants. He joined the firm in 1948 and during that time handled Labor Relations and was Manager of high alumina and silica sales until his recent promotion.

Following three years' experience in the Engineering Department of a refractories company, Mr. Fuchs completed more than 25 years' experience as Superintendent and District Superintendent in the production of fireclay, silica and basic brick for one of the world's largest producers of refractories.

FERRO REDUCES PRICE OF UNIFORMAT

A price reduction of Uniformat products has been announced by William G. Cole, Jr., Manager of the Fiber Glass Division of Ferro Corporation. Uniformat is fiber glass, chopped strand reinforcing mat designed specifically for plastic reinforcement.

In quantities of 20,000 pounds or more, the price of Uniformat has been reduced five cents per pound. The new price is 55 cents. In lesser quantities, prices remain the same. Under 20,000 pounds, 60 cents per pound; and less than 2,000 pounds, 63 cents.

NEW TRAINING FILMS RELEASED BY SAFETY COUNCIL

The National Safety Council's new series of human relation training films for foremen is now available. Featuring O'Grady, the safety skeptic from the Council's film, "A Gray Day for O'Grady", this three-film set tells how a foreman learns about people.

"Fragile—Handle Feelings with Care" shows how a foreman learns to value and respect the feelings of his workers; "Call 'Em on the Carpet" shows the various methods foremen can employ to correct workers' faults without incurring ill will; "It's an Order" is a humorous film illustrating how supervisors should give orders so that they are understandable and can be carried out efficiently by the worker.

Prepared under the supervision of the Council's industrial department, the films run 12 minutes each and are available in 16mm sound movies, as well as 35mm sound slidefilms. Further information and prices may be obtained from the National Safety Council, 425 N. Michigan Avenue, Chicago 11, Illinois.

KIMBLE APPOINTMENT

John P. Kearney, Manager of the Industrial and Electronics Sales Division of Kimble Glass Company, subsidiary of Owens-Illinois Glass Company, has been promoted to Manager of new product development.

In this newly-created position, Mr. Kearney will be principally engaged in the development of Kimble's color television bulb program and will also be responsible for correlating work on new glass products.

Formerly associated with DeMuth Glass Works, Mr. Kearney joined Owens-Illinois in 1938. In World War II, he served as a Lieutenant in the U. S. Naval Reserve in charge of the glass phases of the joint Army-Navy development of cathode ray tubes for radar use.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during December 1953 was as follows: *Flat Glass:* A preliminary figure of 31,900 persons employed was reported for December. This is .9 per cent higher than the 31,600 persons employed during *Glass and Glassware, Pressed and Blown:* During December 88,200 persons were employed according to preliminary figures. This is a drop of 2.4 per cent from the adjusted figure of 90,400 for November. *Glass Products Made of Purchased Glass:* A preliminary employment figure of 13,400 is reported for December. Compared with the previous month's adjusted 13,600, a drop of 1.4 per cent is indicated.

Payrolls during December 1953 were: *Flat Glass:* The preliminary payroll figure for December was $13,559,308. Compared with the adjusted November payrolls of $13,474,656, an increase of .6 per cent is indicated. *Glass and Glassware, Pressed and Blown:* Payrolls during December were a preliminary $26,532,324. This is 3.4 per cent below the adjusted $27,472,259 reported for November. *Glass Products Made of Purchased Glass:* A preliminary payroll figure of $3,556,003 was reported for December, which is 1 per cent below the adjusted November figure of $3,593,755.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	January, 1954
Narrow Neck Containers	
Foods	805,189
Medicinal & Health Supplies	1,112,477
Chemicals, Household & Industrial	745,030
Beverages, Returnable	306,578
Beverages, Non-returnable	39,913
Beer, Returnable	127,515
Beer, Non-returnable	386,228
Liquors	596,987
Wines	339,829
Toiletries & Cosmetics	597,093
Sub-total (Narrow)	5,056,839
Wide Mouth Containers	
Foods	*2,842,418
Dairy Products	234,497
Medicinal & Health Supplies	410,373
Chemicals, Household & Industrial	133,380
Toiletries & Cosmetics	142,265
Sub-total (Wide)	3,762,933
Total Domestic	8,819,772
Export Shipments	176,903
TOTAL SHIPMENTS	8,996,675

* This figure includes Fruit Jars, Jelly Glasses and Packers' Tumblers.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production January 1954	Stocks January 1954
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	6,064,274	7,502,553
	Wide Mouth	*3,944,752	*4,017,198
Dairy Products		332,013	305,748
Beverages, Returnable		657,580	1,039,690
Beverages, Non-returnable		65,467	147,719
Beer, Returnable		220,854	301,998
Beer, Non-returnable		542,159	735,310
Liquors		719,723	988,957
Wines		431,500	449,375
TOTAL		10,009,026	11,519,751

* This figure includes Fruit Jars, Jelly Glasses and Packers' Tumblers.

Glass container production, based on figures released by the Bureau of Census, rose for the first month of 1954 to reach 10,009,026 gross. This is 12.5 per cent higher than the 8,889,148 gross produced during December 1953. During January 1953, glass container production was 9,292,650 gross, which is 7.6 per cent less than produced during January 1954.

Shipments of glass containers during January 1954 fell a little below December 1953 shipments to reach 8,996,675 gross. This is 5.4 per cent less than the 9,516,139 gross shipped during the previous month. Compared with the 8,836,534 gross shipped during January 1953, shipments for January this year are 1.8 per cent higher.

Stocks on hand at the end of January 1954 were 11,519,751 gross. This is 7.8 per cent higher than the 10,682,982 gross on hand at the end of December 1953 and 10.4 per cent higher than the 10,427,036 gross on hand at the end of January 1953.

Automatic tumbler production during December 1953 was 4,123,862 dozens. This is a drop of 11 per cent from the 4,635,099 dozens produced during November. Production during December 1952 was 4,959,897 dozens. Shipments also fell off and were reported to be 3,913,846 dozens. This is a drop of 1.8 per cent from the 3,986,370 dozens shipped during November. December 1952 shipments were 4,428,085 dozens. Stocks on hand at the end of December 1953 were 10,184,245 dozens. Compared with the previous month's stocks of 10,715,680 dozens, a drop of 4.9 per cent is indicated. Stocks at the end of December 1952 were 8,910,823 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during December 1953 were 2,443,630 dozens. This is 18.9 per cent off from the previous month's sales of 3,015,412 dozens. During December 1952, sales were 3,295,469 dozens. At the end of the 12-month period ending December 1953, manufacturers had sold a total of 39,765,813 dozens. Compared with the 41,136,908 dozens sold during the corresponding period in 1952, a drop of 3.3 per cent is indicated.

• Ceramic sculpture, glass pottery and enamels by some of the better known American ceramists are on display at the 60th Annual Exhibition of the New York Society of Ceramic Arts at the American Museum of Natural History in New York City.

BROCKWAY "OPEN HOUSE"

About 4000 visitors attended the "Open House" celebration recently held when the Brockway Glass Company observed the formal opening of its new general office in Brockway, Pa.

In playing host to its many guests, the glass container firm provided movies, refreshments, souvenirs and special displays pertaining to the glass container industry.

Built at a cost of $300,000, the new office was occupied in October 1953 and now contains departments of the company which were formerly located in two separate office buildings. The new home office, which covers 24,269 square feet and contains 50 offices and rooms, is completely modern, providing recessed ceiling lighting, acoustatile ceilings, air conditioning and generous use of glass, both structurally and decoratively.

C. B. ROE DIES

Word has been received of the death of C. B. Roe, former President of Fostoria Glass Company and who for many years was President of the American Glassware Association.

Mr. Roe was employed by the Fostoria Glass Company for 43 years, starting in the office. He was made Chairman of the Board of that company in 1945, having served in many executive capacities, including Vice President and President. Upon his retirement as President of Fostoria, he was unanimously elected a Life Member of the American Glassware Association's Board of Governors.

REFRACTORIES COMMITTEE OF CERAMIC ASSOCIATION HOLDS MEETING

The seventh meeting of the Advisory Committee on Refractories, Ceramic Association of New Jersey was recently held at Rutgers University, under the chairmanship of John M. Kreger, Valentine Firebrick Division of the A. P. Green Firebrick Company.

Dr. Robert B. Sosman of the Rutgers School of Ceramics reviewed current research at Rutgers and its relation to problems in refractories. He also discussed a new crystalline phase of silica, which he proposed to name "keatite" after the discoverer, Paul P. Keat, a graduate student of the school who is now with Norton Company. The new phase differs from the well-known phases quartz, tridymite and cristobalite. It is produced under hydrothermal conditions above the critical point of water.

and here's how...

Due to its superior fluxing qualities, Borax will tend to reduce your batch melting time . . . while enabling you to produce a bottle with fewer checks.

Write to Stauffer's Technical Sales Division for more information about F. M. Smith Brand Borax and the way it can increase your pack and reduce production costs.

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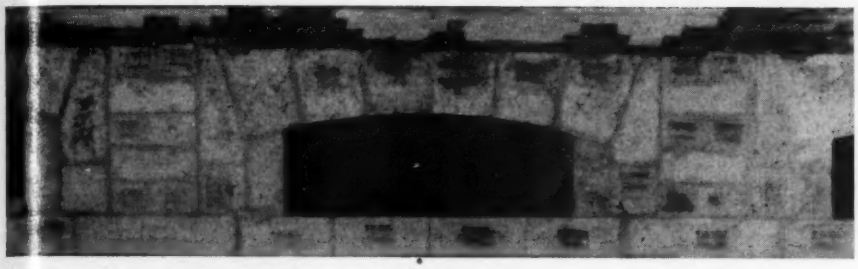
The trend is to **MONOFRAX®**

FUSED CAST
refractories



TO AVOID SUPERSTRUCTURE RUNDOWN

it's essential to use refractories with a really low percentage of glassy phase. For, as you know, this matrix will ooze and become a possible source of stones and cords. What's more, the exposed crystals either flake off into the tank or become part of the drip.

The answer is to use MONOFRAX H fused cast refractories. This material is practically devoid of glassy matrix. It's over 99% beta alumina, and has less than 0.5% interstitial glass! Hence, there is far less chance of honeycombing, bleeding, and spalling. You have a virtually dry superstructure. And there's less chance of eutectic formations from the batch dust.

THREE MORE COMPANIES have just decided to pave tank bottoms with MONOFRAX MH blocks. This is the first time they've ever used our fused cast refractories in this part of the tank. Their decision, in each case, was based on the performance of this material in other locations. Plus the fact that they know of its high resistance to downward attack and upward drilling—the main factors in getting long bottom life.

CARBORUNDUM
Registered Trade Mark

Dept. L-34, Refractories Division
The Carborundum Company, Perth Amboy, N. J.

New Equipment and Supplies

FURNACE AND OVEN CONTROL PACKAGES

The Bristol Company, Waterbury 20, Conn., has made available complete control packages, individually designed for specific furnace, oven, kiln or dryer applications. The separate packaged systems are offered, enabling a designer with a particular heating problem to select a complete control system engineered to satisfy his particular requirements.

These Bristol-Beck control packages are designed to operate on-off or proportional fuel valves or electric contacts in a variety of control systems, including proportional, proportional-input, on-off or time-program; automatic reset is also available. They include all components necessary for a complete installation, including a Bristol Dynamaster Pyrometer, a Beck Relay or Putmo Controller, and a Beck Motor operator.

HEAVY DUTY MULTI-WHEEL GRINDER

Norton Company, Worcester 6, Mass., has announced its Type CM-1 heavy duty multi-wheel grinder in which a number of grinding wheels are mounted on a heavy duty spindle between cartridge type bearings. In a single plunge grind, these wheels grind multiple diameters which may be of different dimensions.

Normally the downtime required to remove the grinding sludge from these wheels would be considerable. To provide automatic and continuous sludge removal, Norton engineers adapted certain components of the Delpark filter, made by Industrial Filtration Company, Lebanon, Indiana. This unit consists of an endless chain belt type conveyor on which rides a strip of disposable filter material. The conveyor forms a trough into which the used collant falls. As the filter medium becomes loaded, a float control advances the conveyor to bring clean filter material into position. The swarf which has been filtered is collected on the filter medium in a metal receptacle for easy disposal. With such a filter arrangement, the collant sump on the machine will rarely require attention.

PACKAGED TEMPERATURE CONTROL

Wheelco Instruments Division, Barber-Colman Company, Rockford, Illinois, has announced its new Pereco Model FG-43 general purpose heat treating furnace which incorporates temperature indication, control and permanent record, plus completely automatic time-temperature program control for full heating and cooling range.

A Wheelco Capacilog provides continuous, automatic indication, control and permanent record of all temperatures up to 2700°F. Simple, plug-in design of the instrument is said to offer an extremely flexible control system and simplify routine maintenance and service. Accuracy of the measuring system is within ¼ of 1%. Added features are the convenient external control setting, large calibrated indicating scale, and automatic chart rewind and tear-off mechanism.

ROLL-O-MATIC MASONRY SAW

Robert G. Evans Company, 6315 Brookside Plaza, Kansas City 13, Missouri, has announced the 1954 Target Roll-O-Matic masonry saw, designed to give faster and safer cutting.

An operating handle is provided for instantly raising or lowering the cutting head to the exact position required for different size masonry materials. Within seven seconds, the blade can be raised from 1″ thick floor tile to a 16″ concrete block.

Another feature is the entirely new safety-lock which locks the cutting head solidly in position. The cutting head cannot jump or be forced out of position. This is accomplished by two handy toggle pins which are inserted to provide the lock. For complete portability, safety-lock toggle pins are merely released and the cutting head is lifted off.

CATALOGS RECEIVED

Pangborn Corporation, Hagerstown, Maryland, is distributing a new four-page, two-color, Bulletin 916 describing the Unit-Type CN cloth bag dust collector.

The bulletin tells how dust control for all types of finely divided dry dusts can be provided for smaller volume applications at low equipment and installation costs. It points out how the collector was designed for indoor use permitting clean air to be discharged inside the plant, a practice which results in a distinct savings where air is heated or cooled.

Detailed descriptions of the dust collector operation and the cloth bag sealing mechanisms are presented. Also included are the construction and assembly features of each dust collector.

The Mullite Refractories Company, Shelton, Conn., has just announced publication of a 16-page catalog covering "Shamva" Mullite refractory specialties. The catalog includes data on the development, physical properties and advantages of Shamva super-refractories, in addition to illustrations and descriptions of typical installations.

Separate sections give complete details and uses of ramming mixes, mortars, patching mixes, castables, plastic mixes and special refractory products. A convenient reference chart in the back gives specifications on all mixes for grain size, weight, method of shipping and installing, standard packaging, etc. Also included is a description of the production and research facilities available at Mullite.

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pa., has issued its Bulletin FS-230 featuring the laboratory oven, an apparatus equally important to research, testing, quality control and educational laboratories.

The 8-page bulletin lists and describes the complete line of Fisher "isotemp" ovens, summarizes the basic studies in heat transfer that led Fisher engineers to turn the conventional "box" heated by warmed air into a uniform-temperature apparatus heated by its own aluminum walls.

Kaiser Aluminum & Chemical Corporation, Chemical Division, 1924 Broadway, Oakland, California, has published a new, illustrated tour book describing the only completely integrated processing facilities for the manufacture of basic refractories.

The 16-page, two-color publication deals with the firm's dolomite quarry and plant at Natividad, California, and magnesia seawater and refractory brick plants at Moss Landing, California.

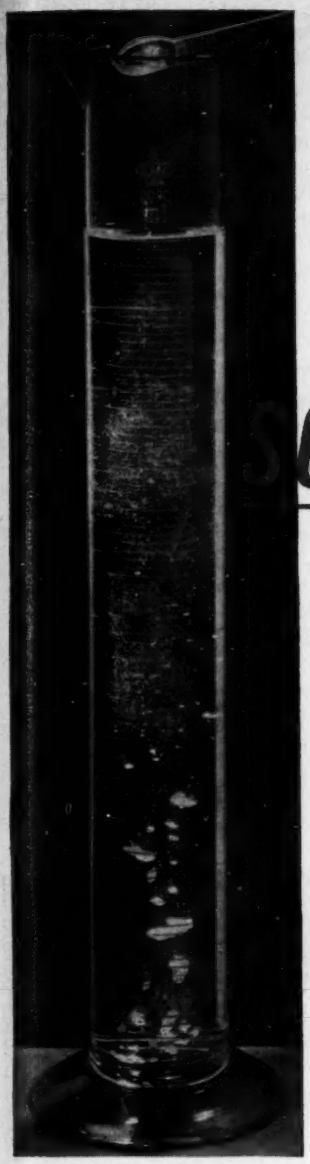
Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass., has published a new brochure, "A Few Case Histories", which contains a random sampling of cases in which the engineering organization has participated.

The Bin-Dicator Company, 13946-36 Kersheval, Detroit 15, Michigan, has issued a new catalog which describes and illustrates the company's products.

The new catalog supplies complete installation data for various types of units—for thick or thin-walled bins, for inside or outside locations and for suspended interior installations. Several new and improved models are available which will make the new catalog useful to the many engineers and superintendents who use Bin-Dicators.

Fish-Schurman Corporation, 70 Portman Road, New Rochelle, New York, has published an enlarged and comprehensive Catalog DT-353 listing its "Steelset" diamond wheels.

The catalog shows diamond drills for drilling deep holes in Pyrex glass, quartz, ceramics and other hard, brittle material, including unfired carbide, etc. In addition, grinding cup wheels are shown for the grinding of glass, quartz, norbide, carbide, etc. The catalog includes methods of use, suggestions for drilling, grinding, etc.



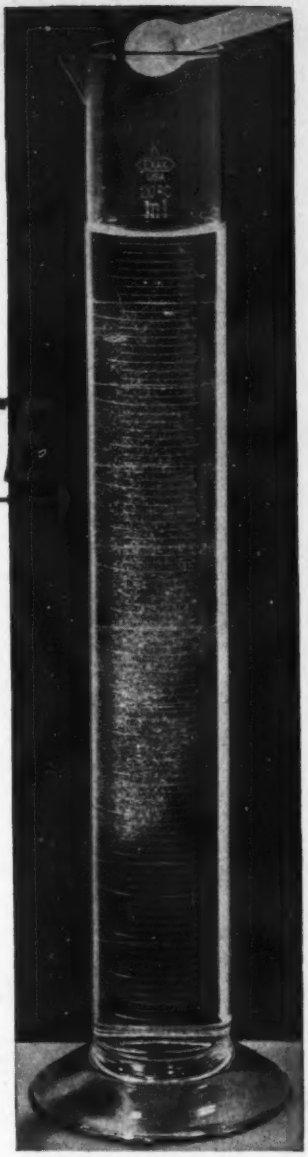
ORDINARY SODA ASH

Visual Evidence of the Exceptional SOLUBILITY RATE of WESTVACO SODA ASH

In your processes you may never be able to see the exceptional rapid solubility of WESTVACO Light Soda Ash as clearly as the camera sees this controlled demonstration. But if you were to examine the needle-like crystalline structure of this unique product, you would see why it has such an excellent rate of solution.

Nature deposited millions of tons of unbelievably pure trona (sodium sesquicarbonate) beneath Westvaco, Wyoming. We refine this unique raw material into Westvaco Soda Ash—which equals or exceeds soda ash made by the traditional synthetic process in both chemical analysis and physical properties.

Users of Soda Ash from the Mississippi Valley to the Pacific benefit markedly by this nearby source of high quality Light and Dense Ash. If you are located in our economic shipping area, we'll be glad to furnish analyses, working samples and prices on the grade you can best use.



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SALES AGENT FOR

WESTVACO CHLOR-ALKALI DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

75,000-WATT ELECTRIC LAMP — LARGEST EVER MADE

A new milestone in the history of lighting was set when a 75,000-watt electric lamp, the world's largest incandescent lamp—was lighted in a ceremony at Rockefeller Center, New York City. The bulb for the huge lamp, which was developed as a feature of General Electric Company's observance this year of Light's Diamond Jubilee, was blown by Corning Glass Works.

Design of the giant lamp was completed by GE lamp development engineers last fall. The glass bulb, one of the largest glass blowing projects ever undertaken by Corning, was blown January 18 in Corning's main plant. A special mold, weighing about 1,500 pounds was cast at the Charleroi, Pa., foundry of Corning and machined at the company's general machine shop in Corning.

The 75,000-watt incandescent lamp measured 38 inches in length and weighed nearly 33 pounds. The completed lamp weighs 50 pounds, stands 42 inches high and has a bulb diameter of 20 inches. The big lamp produces 2,400,000 lumens, or units, of light. The huge lamp is so bright and hot that observers are advised not to look directly at it or stand close to it when it is burning at full brilliance.

• Ned P. Kimberly has been named District Sales Manager of the Cleveland area for the Fiber Glass Division of Libbey-Owens-Ford Glass Company. John A. Webb, formerly field representative for the company's flat glass products in Chicago, has been named a sales representative for the Fiber Glass Division in New York.

NEW GLASS COMPANY TO BE BUILT IN SOUTH AFRICA

A new glass bottle manufacturing plant is being established at Bellville, near Cape Town, South Africa, to supply milk bottles, drinking glasses and a number of other glass products.

The project is understood to involve approximately $300,000 in buildings alone and it is expected that construction will begin within two years. The Union Glass Company is responsible for the program which is designed to meet expanding demands from the Cape for glass containers which at present have to be shipped considerable distances.

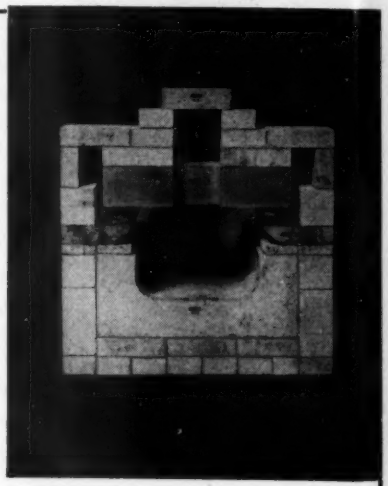
LOBDELL ACQUIRES BRIDGEPORT AND DIAMOND GRINDING LINES

Lobdell United Company of Wilmington, Delaware, has announced the acquisition of the engineering, patterns and tooling and all rights to the manufacture and sale of the Bridgeport and Diamond Lines of grinder, and abrasive cut-off machines. These lines were formerly manufactured by the Bridgeport Safety Emery Wheel Company and the Diamond Machine Company, and by the Columbia Division of Lodge & Shipley Company.

Knife grinders, vertical and horizontal facing grinders, and a number of special purpose grinders make up the grinding line. Abrasive cut-off saws of manual, semi and fully automatic types in a number of sizes make up the new line. Lobdell also makes a cold cutting friction saw for cutting large shapes and bars and the abrasive cut-off machines cover smaller sizes of shapes and bars.

Cleaner Glass, Low Maintenance

with **CRYSTALITE Forehearths**



REMMEY CRYSTALITE (mullite-bonded mullite) is produced in all shapes necessary to make up the forehearth assembly. Burner blocks, cover blocks, channels, spouts, tubes, plungers and orifice rings are built to meet specified requirements. These CRYSTALITE parts mean better, more efficient production by offering:

★ Accuracy in formation to eliminate time-wasting adjustments.
★ High refractoriness and erosion resistance for longer life, fewer replacement shutdowns and cleaner glass.
★ Rigid control through each production phase for uniform quality and dimension accuracy.

Get Premium Performance Without Premium Price . . . by using REMMEY CRYSTALITE parts for your forehearth.

Dependable Refractories

REMMEY

RICHARD C. REMMEY SON CO.
Philadelphia 37 • Pennsylvania

ALL

TYPES AND GRADES

OF FELDSPAR

from one strong producing organization

CERAMIC RAW MATERIALS

GLASS INDUSTRY

Potash and Soda Feldspars, High Alumina—all standard mesh sizes. Low Iron Silica Sand and Aplite.

POTTERY INDUSTRY

Potash and Soda Feldspars for bodies and glazes—all standard mesh sizes. Potters Flint.

PORCELAIN ENAMEL INDUSTRY

Potash and Soda Feldspars for all types of porcelain enamel—all standard mesh sizes. Ground Quartz.

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with 22,000 Acres of Reserve Land

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NORTH CAROLINA
Kona, Spruce Pine

SOUTH DAKOTA
Custer, Keystone

TENNESSEE
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VIRGINIA
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Consolidated built large volume production by pioneering feldspar flotation and today maintains rigid control of quality by continuous analyses at its modern laboratories.

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Dept. of INTERNATIONAL MINERALS & CHEMICAL CORPORATION

General Offices: 20 North Wacker Drive, Chicago 6 • Sales Offices: Chicago, Ill.; East Liverpool, Ohio; Erwin, Tenn.; Trenton, N. J.; Ottawa, Ont.

NEW PACKAGE FOR HYDROMETER JARS

A new box, developed by Hinde & Dauch, used by the Doerr Glass Company will accommodate 36 glass hydrometer jars. The package presents a reduction of 50% in box size, lower initial packing costs, less packing time required and an appreciable savings in freight charges.

At first examination, the new box appears to hold only 18 jars, but die-cut packing pieces at the top and bottom of the box conceal the bases of 18 additional jars, giving the appearance of only half the contents it actually holds.

Besides taking up half as much room in storage, the new box weighs about 25% less and cuts 5 minutes off packing time formerly required. Before adopting the new box, Doerr Glass Company made a test shipment from the company's Vineland, New Jersey, plant to Chicago and return. The box came through the test in excellent condition, without breakage or damage of any kind to its contents.

CHAS. TAYLOR APPOINTS DISTRICT SALES MANAGERS

The Chas. Taylor Sons Company, a subsidiary of National Lead Company, has announced the appointment of G. K. Lowe, W. C. Pittman and L. R. Burke as District Sales Managers.

Mr. Lowe joined Chas. Taylor in 1932, shortly after receiving his Batchelor's degree in Ceramic Engineering from the University of Illinois. For the last 17 years, he has been district representative in northern Ohio, western New York and northwestern Pennsylvania. He maintains an office in Cleveland.

Mr. Pittman also holds a degree in Ceramic Engineering from the University of Illinois, joining the company in 1936. His district consists of southern Ohio and parts of West Virginia and Indiana.

Mr. Burke, a graduate of Carnegie Institute of Technology, joined Chas. Taylor in 1937. His district includes western Pennsylvania, eastern Ohio and northern West Virginia. His headquarters are in Pittsburgh.

• Jack W. Watson has been appointed Director of Public Relations and Advertising by Kaiser Aluminum & Chemical Corporation, it has been announced by D. A. Rhoades, Vice President and General Manager.

In container ware batch

B_2O_3*

ANHYDROUS BORAX
ANHYDROUS RASORITE
BORAX—BORIC ACID

Speeds melting rate

Speeds fining rate

Improves durability . . . appearance

Container ware manufacturers are becoming increasingly aware of the merits of B_2O_3 as a minor constituent. A primary source of supply is the Pacific Coast Borax Co. with its continuous record of supplying highest quality boron compounds for more than fifty years. One single organization—from mine to refined product—assures top grade.

PACIFIC COAST BORAX CO.

DIVISION OF BORAX CONSOLIDATED, LIMITED

NEW YORK • CHICAGO • CLEVELAND • LOS ANGELES

HOT OIL COLORS . . .

You get Proved Plant Performance with PEMCO Hot Oil Colors

Hot oil colors harden instantaneously on contact. A second color can be added with no loss of time. Hot oil colors give you versatility, in complete wrap-around designs.

PEMCO Hot Oil Colors are *smooth*, leave little or no screen mark. Many glass decorating plants have used them successfully for over two years.

Our Pemco sales-engineer will be happy to discuss the use of hot oil colors in your operations. Just drop us a line.

WORLD'S FINEST PEMCO

PEMCO CORPORATION **BALTIMORE 24, MD.**

Vitrifiable Glass Colors • Screening Pastes • Satin-Etch
Porcelain Enamel Frits • Glaze Frits • Stains • Colors

REFRACTORIES APPLICATION . . .

(*Continued from page* 130)

and the zirconia-alumina products are extremely dense in structure, while the beta alumina mix has a porous-like structure and is much lighter in weight.

These three materials are very resistant to high temperatures, volatilized alkalies and batch dust. Because of its crystalline structure, the more porous beta alumina product has shown the greatest resistance to thermal shock of all fusion cast mixes. Due to the practical absence of interstitial glass and with a very minor inclusion of undesirable impurities, the two high-alumina refractories tend to remain dry in service, showing little or no sign of drippage and flaking usually experienced with other products. For the same reason, the denser high-alumina product shows the greater resistance to grooving and attack by silica rundown. While the more porous high-alumina mix is ideally suited for most superstructure applications, there are points of service under certain operating conditions where the denser material may offer added benefits.

The thermal conductivity of the higher-porosity beta alumina product is lower than that of other fusion cast mixes. Two other characteristics of this particular product make it extremely attractive for superstructure service. Unlike other fusion cast mixes, it is practically free of a shrinkage cavity common to this type of product, and the finished block can be easily cut or sawed without the use of a diamond wheel.

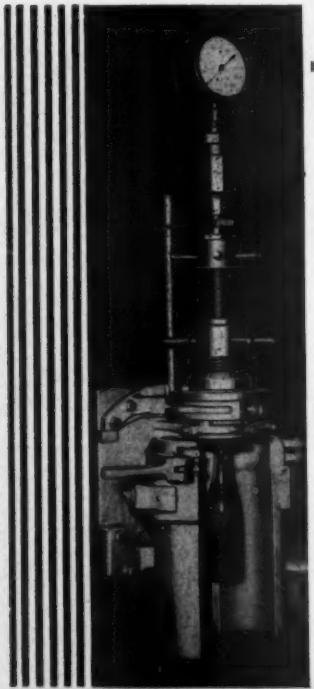
In addition to the all-important points of block life and tank balance, more attention than ever before is being given to the effects that both sidewall and superstructure refractories may have on glass quality. It is the opinion of many that more than 50% of refractory stones in the finished glass originate in the melting and superstructure materials. Dividends may therefore be reaped through a more careful and proper selection of refractories for the service areas under consideration.

With good engineering on the part of tank engineers and with improved refractories made available by the refractories industry, glass manufacturers are establishing all-time records in the way of tank life and glass production. With the proper applications of the quality refractories available, continued progress in this direction is expected. It appears that fusion cast will play a still larger part in the future program of the glass industry. Glass quality will be more highly spotlighted, with an eye on purity of refractories for glass contact and superstructure service as a definite source of help.

OWENS-CORNING ACOUSTICAL TILE EXPANSION PROGRAM

The first phase of a $500,000 program of expansion and improvement of its acoustical tile manufacturing facilities at Newark, Ohio, has been completed, according to an announcement by Owens-Corning Fiberglas Corporation.

The company said a new automatic production line is now in operation to manufacture perforated, textured and Stria tile, and blanks for the Sonofaced products. A second and similar line will be completed this year.


MAXIMUM INDICATION GAUGE with Manual Reset Free Pointer
Wheel to Control Hydraulic Ram
Wheel to Seal Bottle Gasket
Latch to Lock Safety Shield

UNIT FOR TESTING VARIOUS SIZES AND KINDS OF CONTAINERS

BREAKAGE THAT *SAVES!*

with the TECO O. N. Break Type **BOTTLE TESTER**

Tested glass containers are logically better containers. Testing helps eliminate possible "kick-backs" from ultimate users.

Offering a safe, satisfactory line of TECO-TESTED glass containers effects an all-around saving for manufacturer, dispenser and consumer.

The popular TECO O. N. Break Type Tester operates with maximum speed, safety and accuracy.

ACCURATE TEST is obtained. No increment factors involved as with weight-type testers.

TESTING IS SAFE — Bottle or container breaks in a safety shield and pieces drop harmlessly into a container.

TESTING IS FAST—no weights to handle—required operations are simple and convenient.

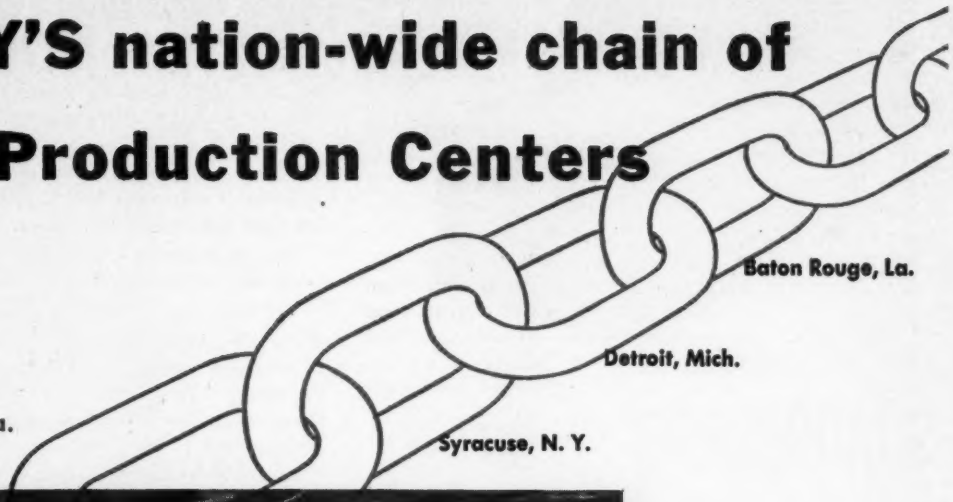
BREAKING PRESSURE temporarily recorded by manual reset pointer.

TOLEDO ENGINEERING Company

GLASS MELTING and MANUFACTURING EQUIPMENT

• 3001 SYLVANIA AVENUE, TOLEDO 13, OHIO

The Newest Link in SOLVAY'S nation-wide chain of Great Production Centers



To Better Serve You with an additional source of supply, SOLVAY announces the start-up of its chlorine-caustic soda operations at the new Perkins Plant at Moundsville, W. Va.

Equipped with the Most Advanced Facilities in the industry—this new plant represents the last word in modern manufacturing equipment and efficient production methods. Very shortly this plant will also be producing Methyl Chloride, Chloroform, Methylene Chloride and Carbon Tetrachloride.

The Addition of this New Producing Center to the four points from which SOLVAY has been shipping carload quantities places SOLVAY in an even better position to give you quicker, more efficient deliveries.

Whatever Your Requirements—SOLVAY is ready to help you with problems involving the processing, handling or storage of SOLVAY products . . . assist you in the development of a new or improved process.

Your Needs and Problems are handled by SOLVAY's trained and experienced *local* field representatives operating out of SOLVAY's 13 branch offices. And whether you're a small or large manufacturer—you're always sure of receiving the close, personal attention that best fits your *individual* needs!

For Dependable Quality . . . Plus the Extra Services that help you meet today's keen competition—make your first call—SOLVAY!

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Soda Ash • Snowflake® Crystals • Potassium Carbonate
Calcium Chloride • Sodium Bicarbonate • Ammonium Bicarbonate
Cleaning Compounds • Caustic Potash • Sodium Nitrite • Ammonium Chloride
Chlorine • Caustic Soda • Monochlorobenzene • Para-dichlorobenzene • Ortho-dichlorobenzene

SHADOGRAPH . . . for Fast, Precision Weighing

SHADOGRAPH's shadow-edge indication is projected by a beam of light, eliminating all friction of indicating mechanism and increasing visible accuracy over 300%. Greater speed is achieved through reduction of lever movement and by the action of an adjustable damping device. Accurate reading can be made from any angle without danger of parallax. Ideal for precise compounding or other uses where extreme accuracy is a must. Available in capacities from 50 grams to 1500 grams; sensitivity as fine as 12 milligrams. Send coupon for complete details.

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RESEARCH DIGEST . . .

(*Continued from page* 145)

(4) With semilogarithmic coordinates, the difference between 4 and 1 is the same as the difference between 40 and 10. Since we do not know to any degree of accuracy the amount of flow required, but only know that we want twice as much or one-fourth as much, the semilogarithmic graph more accurately represents our knowledge.

(5) It will be found that sections where only natural radiation cooling is effective plot as very nearly straight lines on semilogarithmic paper.

Certain tentative conclusions can be drawn as to the properties of the point velocity curve.

(1) When the point velocity curve rises to a peak and drops off quickly, there is a point at which there must be a strong return current with consequent stirring and turbulence. This is best exemplified by the effect of a shade wall. These peaks then should be of value in the melting and refining sections, but should be absent in the conditioning section and/or canals.

(2) A continuous and uniform drop probably represents the best conditions in the conditioning section.

(3) The final level represents the quantity of glass available at the forming machine. We must remember that this does not take into account the pull of the machine, which is negligible in most cases.

(4) This final level, when combined with the known final temperature, represents the quantity of sensible heat available.

(5) The velocities on each side of the hot spot may be compared to see how much surface pull there is to keep the batch back or to pull it down the tank.

(6) It must be kept in mind that this point velocity curve does not take into account the vertical temperature gradient. A highly heat absorbing glass, for example, may require a considerably larger surface velocity to cause an equal volume of glass to flow since the lower levels are much colder and the return flow on the bottom much slower.

This paper has considered only a few of the problems in designing and operating a glass tank. It should be emphasized that this method is only of value when combined with experience. After the "point velocity curves" have been drawn for both successful and unsuccessful operations and the results compared, it should be possible to use them in studying proposed changes. They also form a valuable tool in determining optimum conditions of operation of an existing tank.

ALFRED FACULTY MEMBERS SPEAK AT CERAMIC MEETING

Dean John F. McMahon and Professors George Kirkendale and Leon Bassett of the New York State College of Ceramics at Alfred University presented papers at the 52nd annual convention of the Canadian Ceramic Society recently held in Ontario.

Professor Kirkendale spoke on "A study of Post Cooling Stresses in a Fired Glaze"; Dean McMahon presented a paper on "Contribution to the Knowledge of Wollastonite as an Industrial Mineral"; and Professor Bassett's topic was "Spectrographic Analysis of Glass".

For The Manufacture of Glass and Ceramics

Better Products EVERY TIME

WITH
THREE ELEPHANT* BRAND

PYROBOR
(ANHYDROUS BORAX)

BORIC ACID
BORAX
and
Trona† SODA ASH
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TRONA
INDUSTRIAL AND AGRICULTURAL CHEMICALS

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Glass and Ceramic manufacturers depend on Three Elephant Brand Pyrobor, Boric Acid and Borax for better products at lower cost. In glassware the use of BORAX imparts resistance to thermal shock, durability, strength, color, brilliance, clarity and beauty. In the preparation of vitreous enamels or glazes PYROBOR (Anhydrous Borax $Na_2B_4O_7$) effects material savings because there is no waste of heat or time in driving off water of crystallization before fusion. Whatever your production problem—in glass or ceramics—it will pay you to specify Three Elephant Brand products as your source of Borax. Consult us for specific recommendations.

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PROVED CHEMICALS FOR THE GLASS AND CERAMIC INDUSTRIES

Milestones in Glass Progress

FIRST PLATE GLASS CAST BY CAPT. J. B. FORD

1870 This mirror contains the first piece of plate glass cast commercially in the U.S. by Captain J. B. Ford in 1870. It heralded a new industry in America . . . one that was destined to contribute materially to the well-being of millions. Because this milestone in glass progress was cast in Capt. Ford's plant, it is particularly fitting that we feature it.

1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (North Plant shown above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has literally grown up with glass. Today, as in the past, it is a working partner, supplying raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte
CHEMICALS

Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

GLASS AS A POLYMER . . .
(*Continued from page* 138)

non-stabilized types of glass, will benefit greatly along these lines.

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(14) Cf. M. L. Huggins and J. M. Stevels, J. Am. Ceram. Soc., to be published before long.

WALL COLMONOY EXPANDS SALES FORCE

Further expansion of the sales force of Wall Colmonoy Corporation has been announced by William P. Clark, Vice President, with the appointment of new sales engineers in the company's New York and Pittsburgh offices.

A. D. Arnaut joins the New York sales force as sales engineer. He is a metallurgical engineering graduate of the University of Wisconsin and was Assistant Sales Manager in the New York office of the Denver Equipment Company before joining Wall Colmonoy.

M. R. Price is the new sales engineer in Pittsburgh. He is a mechanical engineering graduate of the University of Pittsburgh. Prior to joining Wall Colmonoy, he was an engineer for Jones and Laughlin Steel Company.

AMCO

Design, Erection and Operation of Manufacturing Plants and Furnaces for All Types of GLASS WARE

AMSLER MORTON CORPORATION
CHAMBER OF COMMERCE BUILDING, PITTSBURGH 19, PA.

INVENTIONS AND INVENTORS . . .
(*Continued from page* 144)

K_2SiF_6, 50 parts $NaHSO_4$, and 40 parts Na_2SO_4. A suitable treating solution is produced by adding from 3 to 6 ounces of such a preparation to a gallon of water. The glass is merely immersed in the solution either at room temperature or preferably at an elevated temperature of about 140°F.

The patent contains two claims and the following references were cited: 1,016,928, Bishop, Feb. 13, 1912; 1,835,390, Textor, Nov. 1, 1932; 2,118,386, Swinehart, May 24, 1938; 2,413,365, McCoy, Dec. 31, 1946; 318,344, Great Britain, Sept. 5, 1925; 449,275, Great Britain, June 24, 1936; and 470,413, Great Britain, Aug. 16, 1937.

HOMMEL COMPANY NAMES ASSISTANT TO PRESIDENT

Ernest M. Hommel, President of The O. Hommel Company, has announced the appointment of Parker H. VanPelt to the position of assistant to the president. Mr. VanPelt will be specifically concerned with the promotion of sales of porcelain enamel frit to the major household appliances manufacturers.

Formerly, Mr. VanPelt was associated with the U. S. Steel Corporation, having first worked in its subsidiary, The American Sheet and Tin Plate Company. He was connected with the operating department in both sheet and tin mill producing units for a number of years, later becoming active in the metallurgical department and then sales.

TROUBLE MAKER!

Tiny dust particles can cause trouble out of all proportion to their size . . . they create hazardous fire and explosion conditions; they clog and cause excessive wear to valuable machinery; they create unfavorable working conditions and often render the best laid community relations campaigns ineffective.

Effective dust control can eliminate all of these troublesome conditions. To get the facts on how you can determine the scope of your dust problem and the most efficient equipment for effective control, write for our new manual, "A Simplified Test Method for Dust Control Determination."

For your copy, just clip this ad to your company letterhead and sign your name and title.

dustex CORP.
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Why

CALUMITE?

Why has Calumite in just a few short years become an established batch ingredient for amber and other colored glass?

Because

1. **Its efficiency and economy have been proven where only facts count . . . in actual production.**
2. **It offers a low cost source of alumina.**
3. **It expedites melting . . . makes it easier.**
4. **It helps produce glass of better quality and raises production.**
5. **It offers uniformity.**
6. **It assures positive control over quality since it affords a method of mathematical approach to glassmaking.**

These are some of the reasons why Calumite has won industry-wide acceptance in only a few short years.

For more complete details, write or call

The Calumite *Co.*
HAMILTON, OHIO

Kahle

FOR VACUUM
largest producer of
EXHAUST MACHINES
covers the most complete range of products to be vacuumized

Kahle makes exhaust machines to evacuate lamps smaller than a grain of rice for use in cystoscopes—and for eight feet long fluorescent lamps.

Kahle makes exhaust machinery that is stationary, automatic and combination (machines that exhaust and seal in one operation, machines that exhaust, vacuum metallize and mercury feed simultaneously, etc.). Kahle machinery will fit into any operation whether small scale or demanding outputs up to 2000 units each hour!

Among various items for which Kahle has made exhaust machinery are:

LAMPS: gas-filled, miniature, photo flash, incandescent, fluorescent and special lamps

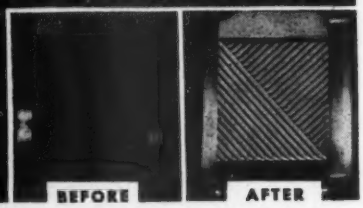
ELECTRON TUBES: sub-miniature, miniature, cathode-ray, standard, power, X-Ray

MERCURY SWITCHES • VACUUM BOTTLES
INSTRUMENTS • TRANSISTORS

Regardless of what product is to be exhausted, write KAHLE, largest exclusive manufacturer of custom machines for the glass, lamp and electronics industries.

Kahle ENGINEERING COMPANY
1314 Seventh Street • North Bergen, New Jersey

Hydro-Finish leaves glass molds
READY for USE!

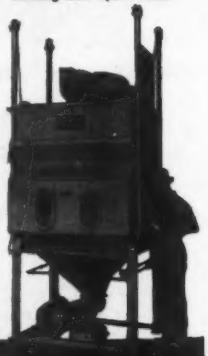


Actual unretouched photos of mold before and after cleaning with Hydro-Finish

Complicated molds are easily cleaned and left *ready for use* with Pangborn Hydro-Finish! Hand cleaning and polishing is virtually eliminated! And you save additional time and labor because a Hydro-Finish machine, operated by one man, removes discoloration and scale in *minutes* instead of hours!

What's more, Hydro-Finish's use of fine-mesh abrasives suspended in liquid gives you a precision job. Sharp edges are maintained . . . tolerances are held to .0001 . . . molds last longer . . . precision equipment is protected.

Get complete facts on Hydro-Finish and how it can save *you* money! Write for Bulletin 1400-A to: PANGBORN CORP., 3400 Pangborn Blvd., Hagerstown, Md.



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BLAST CLEANS CHEAPER
with the right equipment for every job

CLASSIFIED ADVERTISEMENTS

WANTED

Need for production: Simpson Mixer, Raymond Mill, one or two Vibrating Screens. Please give full particulars. P. O. Box 1351, Church Street Station, New York 8, New York.

GLASS TANK FURNACES

Will pay reasonable price for a copy of Glass Tank Furnaces by Devillers and Vaerewyck, translated by Scholes. Reply Box 147, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

HELP WANTED

GLASS BLOWER. Nationally known research organization, located in the midwest, is seeking an experienced glass blower to make intricate glass apparatus for numerous and varied research programs. Must have initiative, skill and supervisory ability. Liberal benefits, including generous tuition refund for college study. Send resume to Box 148, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

YOUNG CHEMICAL OR CERAMIC ENGINEER, preferably with some experience in glass container manufacture, to be trained to take over complete responsibility of plant laboratory and technical facilities. Work directly with top management with primary emphasis on production and development. Unusual opportunity for capable man who wishes to be limited only by his ability to assume and administer responsibility. Starting salary commensurate with experience; future open. Location, Western Pennsylvania. Address replies to Box 149, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

QUALITY CONTROL. Excellent opportunity as Quality Control Supervisor for medium-sized glass container plant in West Virginia. Ceramic graduate or engineering background preferred, but experience in quality control or packing room may qualify. Immediate employment. Reply to Box 150, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

JUNIOR MOLD ENGINEER. Excellent opportunity for a young man who has had experience with container mold equipment construction. Replies handled confidentially. Send detailed resume of experience and qualifications to Box 151, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

DECORATING DEPT. FOREMAN

Man with full knowledge of silk screening on glass. Semi-automatic equipment. Some mechanical ability required. Plant in Chicago. Room for advancement. Reply Box 144, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

50-YEAR EMPLOYEE HONORED BY HOMMEL

At a gathering of employees of The O. Hommel Company, Ernest M. Hommel, President, presented Herman R. Urbach with his 50-year pin.

Following the presentation, Mr. Urbach briefly spoke on the history of the company and mentioned many interesting things which have happened in the past 62 years since the founding of the firm in 1891.